# HP StorageWorks

# Enterprise Virtual Array 3000/5000 user guide




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Enterprise Virtual Array 3000/5000 user guide

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# About this guide

This user guide provides information to help you:

- Learn about the HP StorageWorks Enterprise Virtual Array and its components.
- Start up your storage system.
- Operate your storage system.
- Understand Command View EVA and its role in the virtual array.
- Understand regulations and specifications.
- Understand EMU-generated error condition reports.
- Understand HSV fault management concepts.
- Install customer replaceable units.

This chapter contains the following sections:


- Overview
- Conventions
- Rack Stability
- Getting Help


## Overview

This section contains the following sections:


- Intended Audience
- Related Documentation


### Intended audience

This book is intended for use by Enterprise Virtual Array customers involved in the installation, operation, and management of the EVA5000 and EVA3000 storage systems and who are experienced with the following:

- SANs and storage systems.
- Networking and virtual storage concepts.
- Enterprise Virtual Array products.

### Related documentation

In addition to this guide, HP provides corresponding information:

- *HP StorageWorks Enterprise Virtual Array Release Notes*
- *HP StorageWorks Enterprise Virtual Array Read Me First*
- *HP StorageWorks Enterprise Virtual Array World Wide Name Label*
- *HP StorageWorks Enterprise Virtual Array Hardware Configuration Guide*
- *HP StorageWorks Enterprise Virtual Array Upgrade Instructions*
- *HP StorageWorks Enterprise Virtual Array Installation Instructions*
- *HP StorageWorks Business Copy License Instructions*
- *HP StorageWorks Command View EVA Online Help*

# Conventions

Conventions consist of the following:

- Document Conventions
- Text Symbols
- Equipment Symbols

## Document conventions

The document conventions included in Table 1apply in most cases.

**Table 1 Document conventions**

| Element | Convention |
|---|---|
| Cross-reference link | Blue text: Figure 1 |
| Key and field names, menu items, buttons, and dialog box titles | **Bold** |
| File names, application names, and text emphasis | *Italics* |
| User input, command and directory names, and system responses(output and messages | `Monospace font: COMMAND NAMES are uppercase monospace font unless they are case sensitive` |
| Variables | *<monospace, italic font>* |
| Web site addresses | Blue, underlined sans serif font text: http://www.hp.com |

## Text symbols

The following symbols may be found in the text of this guide. They have the following meanings:

⚠ **WARNING!**

Text set off in this manner indicates that failure to follow directions in the warning could result in bodily harm or death.

△ **CAUTION:**

Text set off in this manner indicates that failure to follow directions could result in damage to equipment or data.

**NOTE:**

Text set off in this manner presents commentary, sidelights, or interesting points of information.

## Equipment symbols

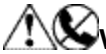
The following equipment symbols may be found on hardware for which this guide pertains. They have the following meanings:



Any enclosed surface or area of the equipment marked with these symbols indicates the presence of electrical shock hazards. Enclosed area contains no operator serviceable parts.

**WARNING:** To reduce the risk of personal injury from electrical shock hazards, do not open this enclosure.

Any RJ-45 receptacle marked with these symbols indicates a network interface connection.

**WARNING:** To reduce the risk of electrical shock, fire, or damage to the equipment, do not plug telephone or telecommunications connectors into this receptacle.

Any surface or area of the equipment marked with these symbols indicates the presence of a hot surface or hot component. Contact with this surface could result in injury.

**WARNING:** To reduce the risk of personal injury from a hot component, allow the surface to cool before touching.

Power supplies or systems marked with these symbols indicate the presence of multiple sources of power.

**WARNING:** To reduce the risk of personal injury from electrical shock, remove all power cords to completely disconnect power from the power supplies and systems.

Any product or assembly marked with these symbols indicates that the component exceeds the recommended weight for one individual to handle safely.

**WARNING:** To reduce the risk of personal injury or damage to the equipment, observe local occupational health and safety requirements and guidelines for manually handling material.

# Rack stability

Rack stability protects personnel and equipment.

⚠ WARNING!

To reduce the risk of personal injury or damage to the equipment, be sure that:

- The leveling jacks are extended to the floor.
- The full weight of the rak rests on the leveling jacks.
- In single rack installations, the stabilizing feet are attached to the rack.
- In multiple rack installations, the racks are coupled.
- Only one rack component is extended at any time. A rack may become unstable if more than one rack component is extended for any reason.

# Getting help

If you still have a question after reading this guide, contact an HP authorized service provider or access our web site: http://www.hp.com.

## HP technical support

Telephone numbers for worldwide technical support are listed on the following HP web site: http://www.hp.com/support/. From this web site, select the country of origin.

**NOTE:**

For continuous quality improvement, calls may be recorded or monitored.

Be sure to have the following information available before calling:

- Technical support registration number (if applicable)
- Product serial numbers
- Product model names and numbers
- Applicable error messages
- Operating system type and revision level
- Detailed, specific questions

## HP storage web site

The HP web site has the latest information on this product, as well as the latest drivers. Access storage at: http://www.hp.com/country/us/eng/prodserv/storage.html. From this web site, select the appropriate product or solution.

## HP authorized reseller

For the name of your nearest HP authorized reseller:

- In the United States, call 1-800-345-1518
- In Canada, call 1-800-263-5868
- Elsewhere, see the HP web site for locations and telephone numbers: http://www.hp.com.

# 1 System description

This chapter provides an overview of the Enterprise Virtual Array and its components.

## Introduction

The HP StorageWorks Enterprise Virtual Array is a high performance, scaled capacity on demand, "virtual" RAID storage solution. A complement of the current modular array family of StorageWorks solutions (ma8000 / ema12000 / ema16000), it can co-exist in the same Fibre Channel SAN while providing 2-Gbps end-to-end Fibre Channel technology readiness.

The Enterprise Virtual Array is available in multiple configurations in 22U, 36U, 41U, and 42U racks. Each configuration is optimized for general-purpose commercial environments and high-performance technical computing environments. The solutions include support for multivendor operating system platforms and stringent data center availability enhancements, such as multipathing and clustering. Refer to the *HP StorageWorks Enterprise Virtual Array v3.020 Release Notes* for information on supported operating systems, Fibre Channel adapters, driver firmware versions, and other support data.

There are two main Enterprise Virtual Array products: EVA5000 and EVA3000. The EVA5000 is available in multiple configurations, ranging from the single-rack 2C2D configuration to the multi-rack 2 x 2C12D + 0C12D configuration. The EVA3000 is available in various configurations, ranging from the 2C2D configuration to the 2C4D configuration. The EVA5000 uses the HSV110 controller, and the EVA3000 uses the HSV100 controller. (See the *HP StorageWorks Enterprise Virtual Array Hardware Configuration Guide* for more information about racks and configurations.)

Figure 1 shows an EVA5000 2C12D configuration in a 41U rack.

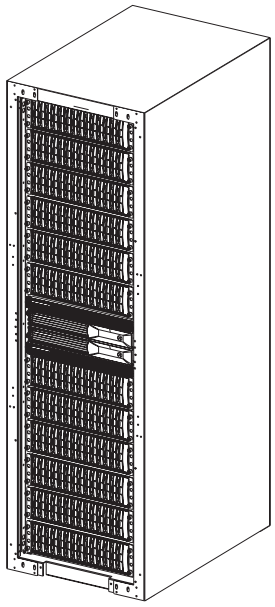



**Figure 1 Enterprise Virtual Array 2C12D configuration**

## Key features and benefits

The Enterprise Virtual Array provides the following features:

- Outstanding self-tuning performance:
  - Virtualization technology, Vraid, enables data to be distributed from 8 to 240 disks to increase disk spindle count far beyond traditional RAID sets. This virtualization method also optimizes storage for the best performance of a specific configuration and application. The Enterprise Virtual Array eliminates tedious management functions to provide the best performance possible.
  - 300 GB 10K RPM disks, increasing the maximum available capacity
  - 250 GB disks
  - Both online (normal, high-performance) and Fibre Attached Technology Adapted (FATA) (lower-performance) drives.

**NOTE:**

Use of FATA drives require VCS v3.020. You cannot use FATA drives without having VCS v3.020 installed.

- EVA3000 (HSV100) single disk enclosure configuration (2C1D)
- Downgrading to an earlier version of VCS without reinitializing the array. This retains all data and avoids time-consuming data restoration.
- State-of-the-art controller software:
  - Improves performance, increases capacity, and allows for easy dynamic storage expansion.
- High-density packaging and support of more disks per controller pair:
  - The EVA5000 offers:
    - Up to 24 TB of storage in a single 41U or 42U rack.
    - Up to 35 TB using 240 disks per controller pair.
  - The EVA3000 offers:
    - Up to 8 TB using 56 disks per controller pair.
    - Up to 22 TB of storage in a single 42U rack.
- Vsnap - Virtually Capacity-Free Snapshot:
  - Replicate data instantly by taking a logical picture of the data without reserving an equal amount of capacity. This process saves significant disk space and improves disk efficiency. Available with the optional Business Copy.
- Virtually Instantaneous Snapclone:
  - Makes a complete copy of your data, which is accessible before the copy completes. The copied data can be used as a test platform for application changes and additional performance benchmarking. Available with the optional Business Copy.
- Integrated configurations:
  - Completely integrated configurations with a single part number, plus disk drives, VCS and system platform software kits.
- Easy-to-use storage management tools:
  - Software tools that allow you to manage larger SAN configurations with more servers and more storage solutions.
- Continuous Access EVA
  - Provides remote data replication functionality on the EVA.

## Virtualization

Virtualization is used to simplify the creation, presentation, and administration of storage to multivendor host servers in a Storage Area Network (SAN). Virtualization changes the way the storage administrator

interacts with storage—streamlining the work required to manage and implement the storage environment. This section describes how virtualization affects storage configuration.

You do not need to make decisions about planning, creating, and configuring stripesets, mirrorsets, and RAIDsets. The software now automates these decisions. The decisions are simplified to basic choices on virtual disk capacity and redundancy levels. All of this work is done from a central location—Command View EVA. See the Command View EVA online help for more information.

Three levels of virtualization are possible within a SAN—server, fabric, and storage system.

- Server level—useful for small ystems—StorageWorks Virtual Replicator implements small scale virtualization of storage in a Windows NT, Windows 2000, and Windows Server 2003, Windows NT, and 2000 Novell NetWare environment.
- Fabric level—SAN-wide virtualization with increased efficiency.
- Storage system level—provides large volumes of pooled storage in virtual disks and simplifies management tasks.

The Enterprise Virtual Array implements storage system level virtualization. Virtualization technology, at the storage system level, creates virtual disks. These virtual disks are created using all the available physical disk drives, not individual or grouped sets of disks. The host recognizes and uses these virtual disks like any other disk device.

Storage system level virtualization is a concept in the storage industry that allows you to focus on higher-level concerns regarding your specific storage needs.

With the Enterprise Virtual Array, you no longer need to manually present storage pools to the host servers. That is, you do not choose specific disks and sets of disks to create levels of redundancy. No decisions need to be made as to which physical disks are involved in each storage unit. When you create virtual disks, the entire set of disks in the cabinet is used for load balancing and sparing, which sets aside extra disk space for failure protection. The Enterprise Virtual Array improves performance because the data is written across many disks and not directed toward a single or specific set of disks.

Setup and management of virtualization is achieved with software and hardware resources. You have greater freedom and control with the following benefits:

- Faster performance with improved system response time
- All SAN and storage management done from a Web browser
- Simplified load-balanced storage
- Simplified decisions about physical disk setup and partitioning
- Increased bandwidth—use of striping algorithms across many disks accessed with multiple spindles
- Simplified high-availability storage techniques
- Recovery from disk failures includes automatic load balancing

## Storage system components

The Enterprise Virtual Array consists of four main components:

- Command View EVA—The management software that communicates with the controllers. Together, Command View EVA and the controllers control and monitor Enterprise Virtual Array storage systems.
- VCS—Virtual Controller Software that allows the Enterprise Virtual Array to communicate with Command View EVA, via the controllers.
- Hardware—The physical pieces that constitute the Enterprise Virtual Array, such as drives, enclosures, and controllers. These pieces are combined in a rack and are connected to the SAN.
- Hosts servers—The computers that attach to the storage pools of the Enterprise Virtual Array and use the virtual disks like any other disk resource.

These components work together to create an entire storage system solution. Management is accomplished by accessing ommand View EVA through your browser.

Figure 2 shows the complete Enterprise Virtual Array storage solution.

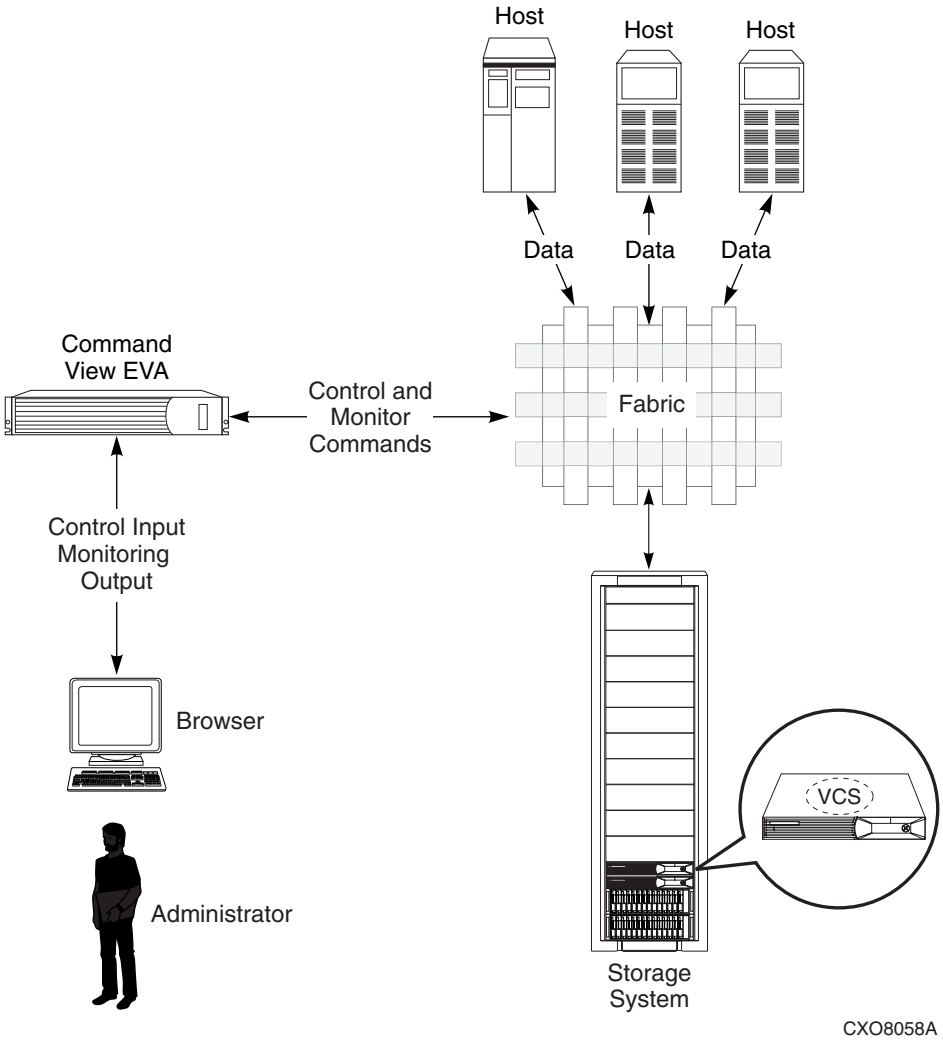



**Figure 2 Enterprise Virtual Array storage solution**

## Command View EVA

As the only user interface to the Enterprise Virtual Array, Command View EVA resides on the HP OpenView Storage Management Appliance (management appliance) and is opened via a Web browser. It is used to perform the following administrative tasks.

- Creating virtual disk families, including selection of Vraid level, cache policy, and host presentation.
- Managing the presentation of Vraid drives to hosts.
- Managing and monitoring storage system hardware.
- Creating snapclones and snapshots of virtual disks.

An online help system is available within the interface, including page-level help.

### Interface layout

The interface is divided into three panes:

- Session pane—located across the top of the window. It contains high-level commands and the name and IP address of the Storage Management Appliance.
- Navigation pane—located on the left side of the window. It contains a tree structure for access to virtual disks, hosts, and other elements of the Enterprise Virtual Array.
- Content pane—located on the right side of the window, below the Session pane. It is the largest window and is where most administrative tasks are performed.

Figure 3 shows the Command View EVA interface main window.

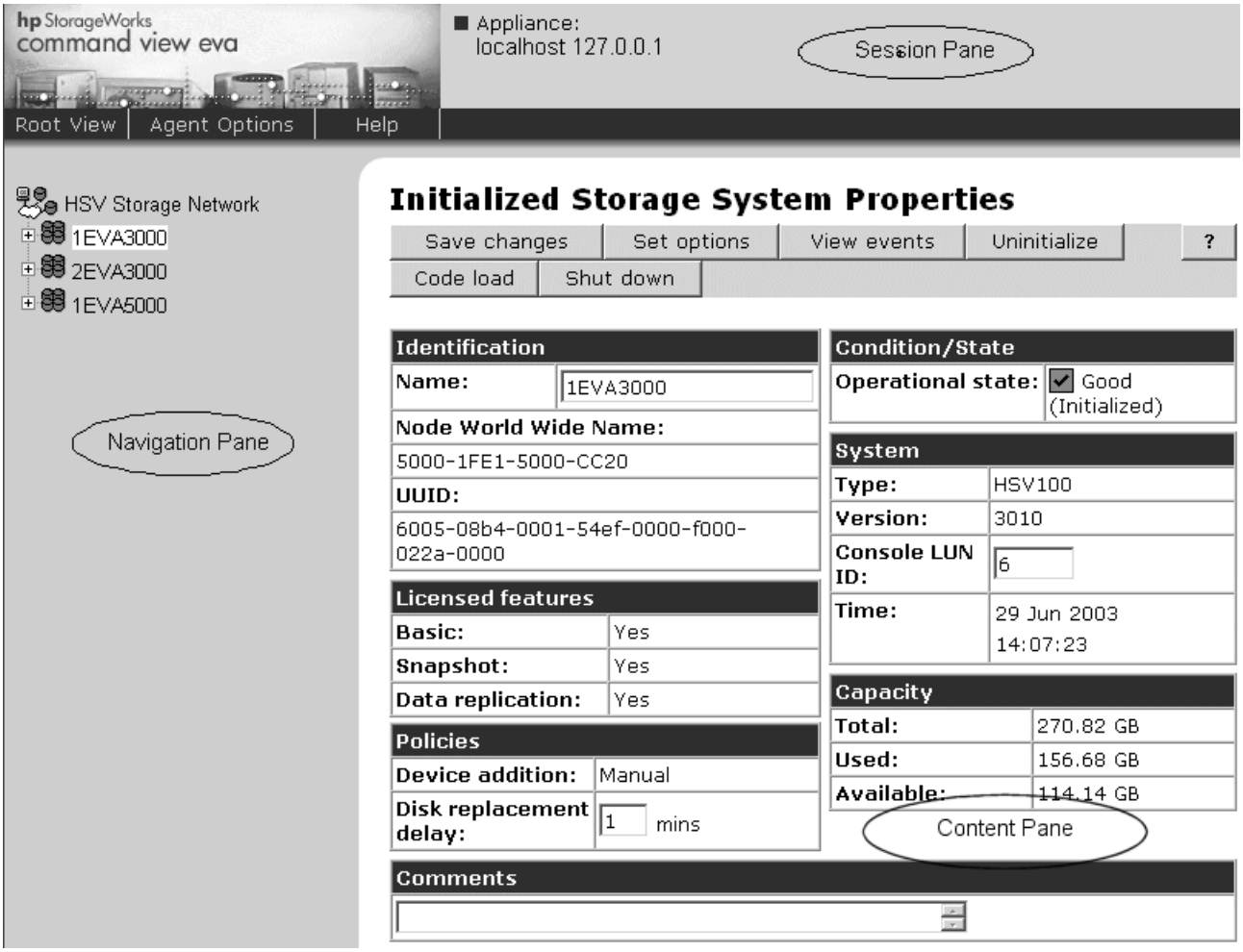



**Figure 3 Command View EVA interface window**

For more information, see Organization of the Interface Window.

## Command View EVA online help

You will find an extensive online help system for Command View EVA. Three levels of help are available:

1. Application—Activated by clicking Help on the Session pane. Application help includes:
   - Navigation by a table of contents
   - Index
   - Keyword search function
2. Page—Activated by clicking the ? button in the Content pane.
3. Field—Activated by clicking the ? symbol, when displayed next to a field.

# Virtual controller software

VCS provides storage controller software capability, including dynamic capacity expansion, automatic load balancing, improved disk utilization, and increased fault tolerance. VCS resides on the HSV controllers and is provided in the HP StorageWorks Virtual Controller Software kit.

## VCS benefits

VCS provides scalable capacity on-demand, helps improve performance, increases disk utilization efficiency, and allows for easy dynamic storage expansion by providing the following features:

- High-density packaging and support of more disks per controller pair. Up to 24TB of disk storage in approximately 5.9 square feet (0.5 square meters) using 168 disks.
- Virtually Capacity-Free Snapshot (Vsnap) function that saves significant disk space and improves disk utilization efficiency.
- Virtually Instantaneous Snapclone copy capability that allows immediate use of the clone copy.
- Simplified storage management, such as server-independent storage management, automatic load balancing, and on-the-fly storage expansion to improve management efficiency.

## VCS features and functionality

VCS provides the following capabilities:

- Support for up to 240 disk drives per controller pair
- Management of up to 512 virtual disks, ranging in size from 1 GB to 2 TB per virtual disk, per disk pool
- Dynamic capacity expansion and virtual disk data load leveling
- Distributed sparing of disk capacity
- Virtually Capacity-Free Snapshot (Vsnap)
- Virtually Instantaneous Snapclone
- Dual redundant controller operation for increased fault tolerance
- Multiple path failover support
- Battery back-up for cache memory
- Asynchronous disk swap (Hot Swap)
- Clustered server support
- Mirrored write-back cache support
- Read-ahead and adaptive read caching support
- Virtual RAID arrays (Vraid0, Vraid1, Vraid5)
- Non-disruptive software upgrade capability
- Supports connection of up to 256 hosts
- Multivendor platform support
- Controller password protection for configuration control
- Selective storage presentation
- SAN-based data zoning

Additional information about HP StorageWorksVirtual Controller Software can be found online at: http://h18000.www1.hp.com/storage/index.html.

## Optional software licensing

Business Copy EVA and Continuous Access EVA require a separate license for each controller pair. Instructions for obtaining a license are included with the software documentation.

Additional information about Business Copy EVA and Continuous Access EVA can be found online at http://h18006.www1.hp.com/storage/software.htm.

## Hardware

The Enterprise Virtual Array consists of the following hardware components:

- Fibre Channel drive enclosure—Holds disk drives, power supplies, blowers, Input/Output (I/O) modules, transceivers, and an Environmental Monitoring Unit (EMU).
- Fibre Channel loop switch—Provides twelve-port central interconnect for Fibre Channel Arbitrated Loops (FC-AL) following the ANSI FC-AL standard.
- HSV Controller—Manages communications between host systems and other devices. A pair of controllers is included in the Enterprise Virtual Array.
- Rack—A variety of floor-standing racks are available.

**NOTE:**

Your Enterprise Virtual Array may consist of one or more of the above hardware elements, depending on your configuration.

## Physical layout of the storage system

The Enterprise Virtual Array consists of a pair of controllers and an array of disk drives. The basic physical components are shown in Figure 4. The disk drives are installed in drive enclosures, which connect to Fibre Channel (FC) loop switches. The controller pair also connects to the FC loop switches. A backplane in the drive enclosures distributes commands and data to the drives. The EVA3000 does not use FC switches on the back end.

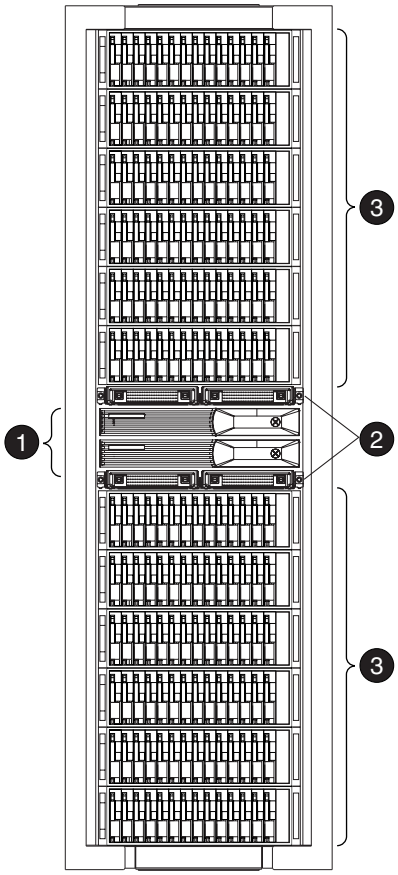



**Figure 4 Storage system hardware components**

1. Controller pair
2. FC loop switch (not used in the EVA3000)
3. Drive enclosures

Each hardware component is identified in the following sections and is described in detail in Storage System Hardware Components.

## Fibre Channel drive enclosure

Each FC drive enclosure includes the following features:

- 3U drive enclosure
- Dual-redundant, active-to-active, 2-Gbps FC loops
- Fourteen 1-inch FC disks per enclosure
- Environmental Monitoring Unit (EMU)
- Dual 2-Gbps FC I/O modules—A and B loops
  - Enhanced fault detection
  - Single Gigabit Interface Converter
- Dual 500-W redundant hot-plug power supplies and blowers

For ease of reference, the disk drives are referred to by their physical location, the drive bay number.

Figure 5 shows the front view of the FC drive enclosure and the physical location of each drive bay.

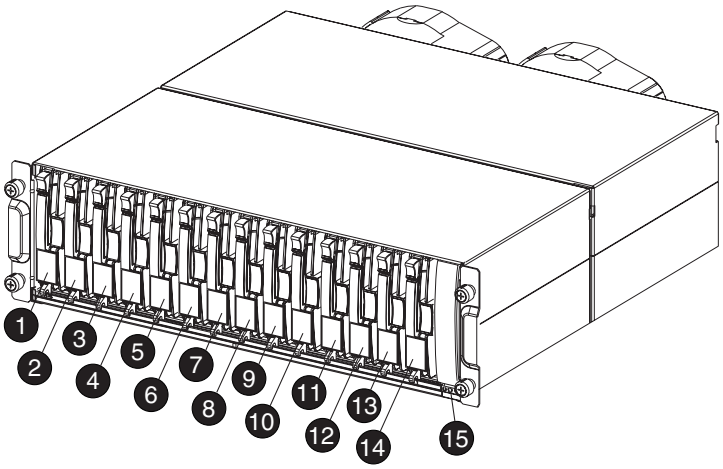



**Figure 5 FC drive enclosure**

1–14 drive bays

15 enclosure status indicators

## Fibre Channel loop switches

The EVA5000 uses four FC loop switches to connect all of the drive enclosures to the controller pair via FC cables. Each switch acts as a central point of interconnection and establishes a fault-tolerant physical loop topology.

The major features of the FC loop switches are:

- 2.125 Gbps operating speed
- Twelve ports
- Half-width, 1U size
- System and port status LED indicators
- Universal power supply that operates between 100 to 250 VAC and 50 to 60 Hz
- Small Form-factor Pluggable (SFP) transceivers

Figure 6 shows the bezel and front view of the FC loop switch.

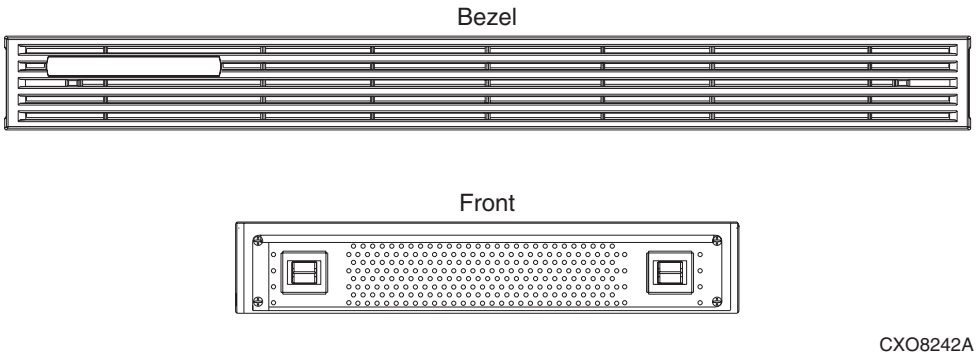



**Figure 6 FC loop switch—bezel and front view**

**NOTE:**

Each bezel covers two FC loop switches in a space capacity of 1U. One "U" is 44.45 mm (1.75 inches) high.

## EVA5000 HSV110 controllers

Two high-performance HSV110 controllers are contained in one EVA5000 rack. Each controller is contained in a separate enclosure and features:

- High-performance microprocessor
- An Operator Control Panel (OCP) for easy operation
- Two 2-Gbps Fibre Channel-Switched Fabric host ports
- Four 2-Gbps FC-AL device ports
  - Arranged in redundant pairs
  - Data load/performance is balanced across a pair
  - Supports up to 240 disks (120 disks per pair)
- 1-GB cache per controller, mirrored, with battery backup
- 2-Gbps FC cache mirroring port with device port backups
- Dual power supplies

The controller is the interface between Command View EVA and the Enterprise Virtual Array (the interface between hosts and disks). It is the interface to your data and performs I/O correctly and reliably. Up to 18 drive enclosures are supported by one HSV110 controller pair.

Each controller pair consists of two controllers. Figure 7 shows the controllers as they reside in the storage system.

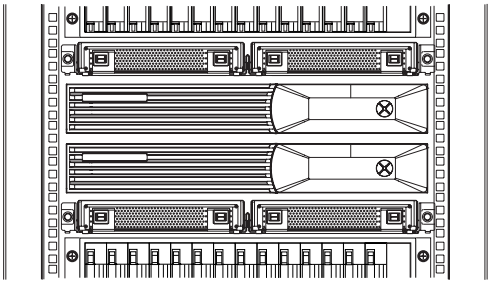



**Figure 7 HSV110 controller location—front and rear views**

## EVA3000 HSV100 controllers

The HSV100 controllers serve as the interface between the storage system hardware and the SAN. All host I/Os and all Command View EVA management commands are processed by the controllers. Up to four drive enclosures are supported by each HSV100 controller pair. Figure 8 shows the HSV100 controller.

Two high-performance HSV100 controllers are included in each EVA3000 storage system. Each controller is installed in a separate enclosure and provides the following features:

- High-performance, PowerPC microprocessor
- An Operator Control Panel (OCP) for easy operation
- 3U cabinet space required for both controller enclosures
- Two 2-Gbps, FC-Switch Fabric host ports
- Two 2-Gbps, FC-AL device ports
  - Arranged as a single redundant pair
  - Data load/performance is balanced across a pair
  - Support for up to 56 disks
- 1-GB cache per controller, mirrored, with battery backup
- 2-Gbps, FC cache mirroring port with device port backups

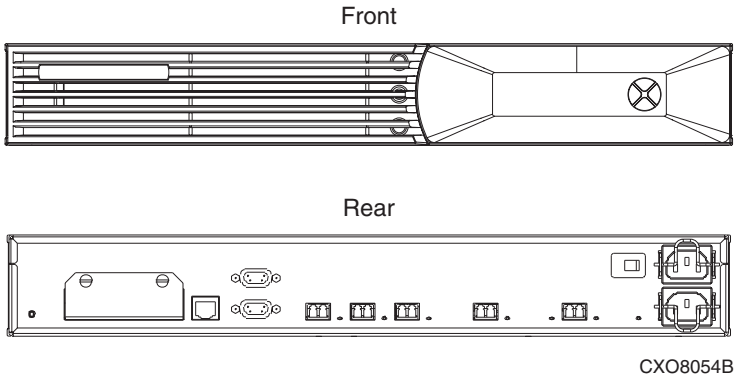



**Figure 8 HSV100 controller—front and rear views**

## Rack

The rack provides the capability for mounting standard 483 mm (19 in) wide controller and drive enclosures.

Three types of racks are available with your Enterprise Virtual Array 5000:

- 9000-Series 42U rack—Available in graphite with a depth of 909mm (35.8 in) with industry standard 19-in mounting rails.
- 9000-Series 41U rack—Available in graphite with a depth of 993mm (39.1 in) with industry standard 19-in mounting rails.
- 10000-Serie 42U rack—Available in graphite with a depth of 1000mm (39.4 in) with industry standard 19-in mounting rails.

Six types of racks are available with your Enterprise Virtual Array 3000:

- Enterprise 42U Rack—Available in graphite.
- Enterprise 36U Rack—Available in graphite.
- Enterprise 22U Rack—Available in graphite.
- Rack System/E 41U Rack—Available in quartz and graphite.
- Rack System/E 33U Rack—Available in quartz and graphite.
- Rack System/E 25U Rack—Available in quartz.

**NOTE:**

Racks and rack-mountable components are typically described using “U” measurements. “U” measurements are used to designate panel or enclosure heights.

The racks provide the following:

- Unique frame and rail design—Allows fast assembly, easy mounting, and outstanding structural integrity.
- Thermal integrity—Front-to-back natural convection cooling is greatly enhanced by the innovative multi-angled design of the front door.
- Security provisions—The front and rear door are lockable, which prevents unauthorized entry.
- Flexibility—Provides easy access to hardware components for operation monitoring.
- Custom expandability—Several options allow for quick and easy expansion of the racks to create a custom solution.
- Housing for all storage system components, including:
  - Cables
  - FC drive enclosures
  - FC loop switches
  - Controllers
  - Power Distribution Units (PDUs)

Figure 9 shows the 42U rack.

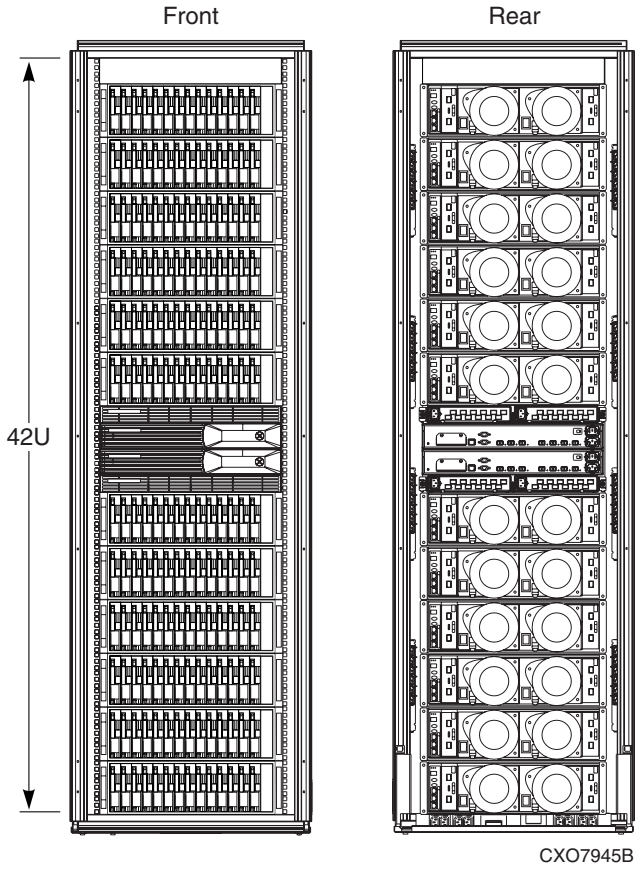



**Figure 9 42U rack**

## Hosts and the Enterprise Virtual Array

This section describes how the host servers fit in the overall Enterprise Virtual Array. Below is a list of the hosts that can attach to and interact with the Enterprise Virtual Array:

- Windows NT, Windows 2000, Windows Server 2003
- Tru64 UNIX
- OpenVMS
- Sun Solaris
- HP-UX
- IBM AIX
- Linux

Be sure you are running a supported version of each operating system in your SAN (see the platform-specific release notes for details).

The hosts are components of the Enterprise Virtual Array storage systems. These host servers attach to the storage pools of the Enterprise Virtual Array and use the virtual disks just like any other disk resource. To the host server, virtual disks appear the same as other storage system disk resources.

## SAN considerations

Ensure that your SAN components are all supported for use with the Enterprise Virtual Array. Design your SAN with an HP standard topology or by following the HP SAN design rules for creating custom topologies. Refer to the *HP StorageWorks SAN Design Reference Guide* for help with topology rules. The most up-to-date version of this guide can be found on the HP web site at http://h18004.www1.hp.com/products/storageworks/san/documentation.html.

# 2 Startup and operation

This chapter provides the procedures necessary to continue installation and startup of your Enterprise Virtual Array. Please contact an authorized HP service representative to assist with installation.

This chapter consists of:

- Storage system connections
- Procedures for getting started
  - Gathering information
  - Setting up the storage system hardware
  - Entering data using the OCP
  - Installing Command View EVA
  - System shutdown and powerup

## EVA5000 storage system connections

Figure 10 shows how the storage system is connected to other components of the storage solution.

- The controller pair connects to two FC fabrics, to which the hosts also connect.
- Command View EVA, through the Storage Management Appliance, also connects to the fabric.
- The controller pair connects to two loop pairs, which connect to the drive enclosures. Each loop pair consists of two loops that run independently, but will run for the other loop if a failure occurs.

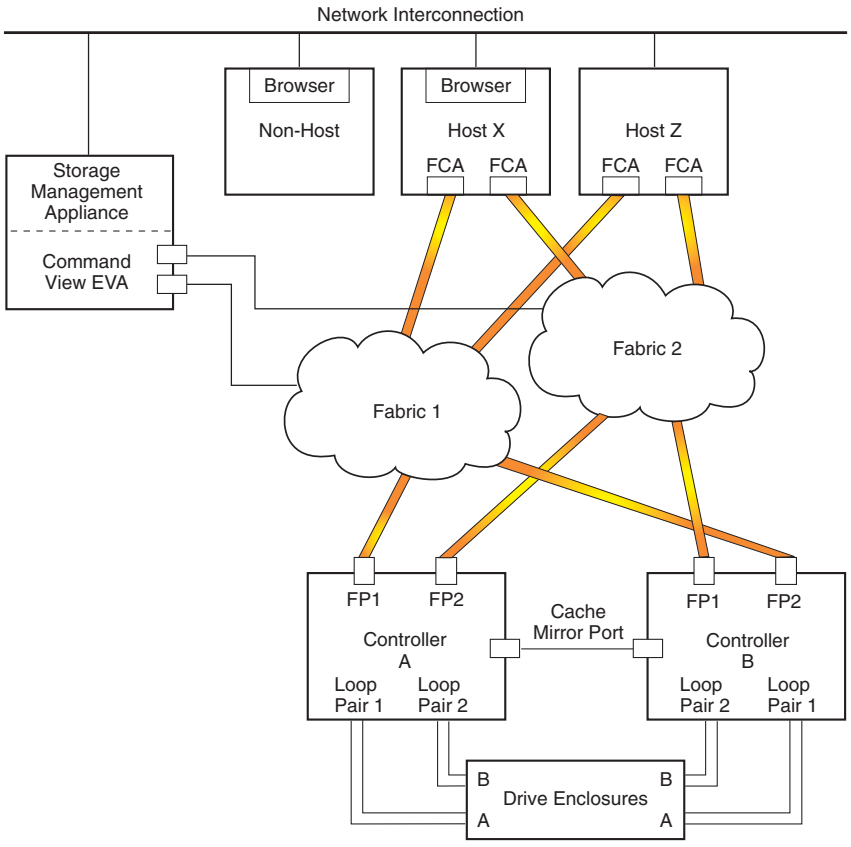



**Figure 10 Block diagram of the storage system's connections**

# EVA3000 storage system connections

Figure 10 shows a typical Enterprise Virtual Array 3000 SAN topology:

- The HSV controllers connect via ports FP1 and FP2 to two Fibre Channel fabrics. The hosts that will access the storage system are connected to the same fabrics. Note that FP1 on each controller is connected to a different fabric to balance the I/O load.
- Command View EVA, which runs on the storage management appliance, also connects to both fabrics.
- The controllers connect through one loop pair to the drive enclosures. The loop pair consists of two independent loops, each capable of managing all the disks should one loop fail.

# Procedures for getting started

Follow the process below to guide you through the installation of the storage system:

1. Gather information and identify all related storage system documentation.
2. Contact an authorized service representative for hardware configuration.
3. Enter the storage system World Wide Name (WWN) into the OCP.
4. Configure Command View EVA.
5. Prepare the hosts.

6. Configure the system through Command View EVA.
7. Make virtual disks available to their hosts. Refer to the storage system software documentation for each host's operating system.

## Gathering Information

Below is important information you need to know prior to operating the Enterprise Virtual Array. Retrieve the items described below to assist you in completing initialization.

Locate the following items to install the storage system:

- *HP StorageWorks Enterprise Virtual Array World Wide Name Label*, which is a separate sheet of paper shipped with the system.
- *HP StorageWorks Enterprise Virtual Array Read Me First* document.
- If you bought a license for the snapshot feature, the instructions for installing license keys are included in the *HP StorageWorks Business Copy License Instructions* document included with your replication license package. If you also bought Continuous Access EVA, licensing instructions are found in the *HP StorageWorks Continuous Access EVA Getting Started Guide*.
- The latest HP OpenView Storage Management Appliance Update, which consists of the management appliance update CD and its associated documentation.

  - You can determine the latest update version available by checking your Release Notes or contacting your authorized service representative to find out how to receive the latest information.
  - The boxed kit for the operating system of the host computer. If there are hosts running different operating systems, you will need a boxed kit for each operating system. This kit ships separately from the storage system.
  - The boxed kit that contains the hardware documentation and ships with the system. That is the box that this manual came in.

Locate these items and keep them handy. You will need them for procedures in the rest of this manual.

### Host information

HP recommends that you make a list of information for each computer (host) that will be used in the storage system. The information you will need for each host is as follows:

- The LAN name of the host
- A list of World Wide Names of the FC adapters, also called host bus adapters, through which the host will connect to the fabric or fabrics that provide access to the storage system
- IP address of each host
- Operating system type
- Available LUN numbers

### Additional documentation

For complete information about all documents that pertain to the Enterprise Virtual Array and any other additional documentation that may be required to operate your storage system, see the HP StorageWorks Enterprise Virtual Array Technical Documentation home page, available at: http://h18000.www1.hp.com/products/storageworks/enterprise/ documentation.html.

## Obtaining a license key

There is no longer a licensing requirement for initialization of the Enterprise Virtual Array storage system controllers and firmware. However, implementation of the value-added Business Copy EVA or Continuous Access EVA products on Enterprise Virtual Array systems does require licensing. Licensing of the snapshot capability on an Enterprise Virtual Array storage system is included as part of the Business Copy EVA

license. Activation procedures for Business Copy EVA and Continuous Access EVA licenses are provided with the purchase of the license.

### Business Copy EVA

Business Copy EVA can create nearly instantaneous copies of any active volume on the Enterprise Virtual Array for use by other applications or systems for batch processing, backup, or testing, without interrupting current workflow. This data replication eliminates data movement between the host and storage device. Business Copy EVA offers licenses for several capacity levels, based on replicated capacity, rather than on total system capacity.

### Continuous Access EVA

Continuous Access EVA provides remote data replication functionality on the EVA and requires a separate license for each HSV controller pair. The Continuous Access EVA license is purchased using its own part number.

## Setting up the storage system hardware

To install the storage system hardware, the following procedures must be performed by an authorized service representative. Contact your service representative before proceeding.

- Complete the prerequisites.
- Verify the site requirements.
- Move the rack.
- Stabilize the rack.
- Inspect the storage system.
- Install the controller cache batteries.
- Apply power.
- Attach the controllers to the fabric.

## Entering data using the OCP

Two pieces of data critical to initial setup must be entered into the OCP:

- WWN—Mandatory to complete setup.
- Storage system password—Optional. A password is a security interlock that allows only specific instances of Command View EVA to access the storage system.

### Setting up a controller pair using the OCP

Fibre Channel protocol requires that each controller pair has a unique Node WWN. This 16-character alphanumeric name identifies the controller pair on the storage system. The Enterprise Virtual Array World Wide Name Label identifies the WWN for each storage system. The Node WWN labels, similar to the one shown in Figure 11, identify the storage system WWN and checksum. During the installation ofthe storage system, two WWN labels are attached to the rack on both sides of the controller enclosures.




CXO7545A

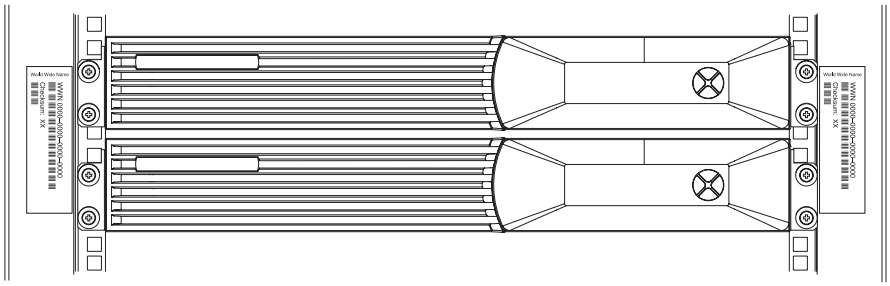
**Figure 11 Sample node WWN label**

NOTE:

The controller pair WWN is unique to a controller pair and cannot be used for any other controller pair or device anywhere on the network. Figure 12 shows the location of the WWN label on a controller pair.

This is the only WWN applicable to any controller installed in a specific physical location, even a replacement controller.

Once a WWN is assigned to a controller, you cannot change the WWN while the controller is part of the same storage system.



CXO7601C

**Figure 12 Location of the World Wide Name label**

### Entering the WWN

Table 2 defines the push button functions when entering the WWN or the WWN checksum.

NOTE:

The following sections describe procedures that require use of the OCP. For more information about the OCP, see Operator Control Panel .

**Table 2 WWN push button functions**

| Button | Function |
|---|---|
| ▲ | Selects a WWN or checksum character by scrolling up through the character list one character at a time.If you select an incorrect character, you can use either ▲ or ▼ to select the correct character. |
| ▶ | Accepts the current character and selects the next character. If you accept an incorrect character, you can move through all 16 characters, one character at a time, until you display the incorrect character. You can then change the character. |
| ▼ | Selects a WWN or checksum character by scrolling down through the character list one character at a time.If you select an incorrect character, you can use either ▲ or ▼ to the select correct character. |
| ◀ | Accepts all the WWN or checksum characters. |

Complete the following procedure to assign the WWN to each pair of controllers. Either controller can be used to input the WWN.

**NOTE:**

This procedure should be performed by an authorized service representative.

1. Place the power switches on both controllers to the Off position.
2. Apply power to the rack.
3. Place the power switch to On on both controllers.

**NOTE:**

Notifications of the startup test steps that have been executed are displayed while the controller is booting. This display may not occur for up to two minutes.

4. The WWN entry display has a 0 in each of the 16 positions.
5. Press ▲ or ▼ until the first character is displayed. Press ▶ to accept this character and select the next.
6. Repeat Step 5 to enter the remaining characters.
7. Press ◀ to accept the WWN and select the checksum entry mode.

**NOTE:**

For the location of the WWN Checksum, see Figure 11.

### Entering the WWN checksum

The second part of the WWN entry procedure is to enter the 2-character checksum, HS, as follows.

1. Verify that the initial WWN checksum displays 0 in both positions.
2. Press Press ▲ or ▼ until the first checksum character is displayed. Press ▶ to accept this character and select the second character.
3. Press ▲ or ▼ until the second character is displayed. Press ◀ to accept the checksum and exit.
4. Verify that the default display is automatically selected. This indicates that the checksum is valid.

If you enter an incorrect WWN or checksum, the system will reject the data and you must repeat the procedure.

**NOTE:**

If a controller pair is powered off with a WWN entered but without the storage system having been initialized, the WWN will be lost and will have to be re-entered.

An active (flashing) display, an error condition, or a user entry (pressing a push button) overrides the default display. When none of these conditions exist, the default display appears after approximately 15 seconds.

### Setting the storage system password

The eight-character storage system password feature enables you to restrict certain functions to selected resource managers. Table 3 describes the push button functions when using the password feature.

**Table 3 System password push button functions**

| Button | Function |
|---|---|
| ▲ | Selects a password character by scrolling up through the character list one character at a time. |
| ▶ | • Moves from the default display to the system menu tree.<br>• Moves from the system password display to the password entry display.<br>• Accepts the current character and selects the next character.<br>If you accept an incorrect character, you can loop through the display, one position at time, to select the character to be changed. |
| ▼ | Selects a password character by scrolling down through the character list one character at a time. |
| ◀ | Accepts all the password characters. |

Complete the following procedure to set the password using the push buttons, as described in Table 3.

1. Determine a unique, eight-character password using uppercase or lowercase letters A through Z.
2. With either of the default menus (Storage System Name or Node World Wide Name) displayed, press any push button to select the menu tree.
3. Press ▼ to cycle through the displays until System Password is active (flashing).
4. Press ▶ to select the system password function.
5. When the System Password function is flashing, press ▶ to select the change password function.
6. To change the password, press ▲ or ▼ to show **Yes** and press ◀.
   The default Enter Password function displays the default password, AAAAAAAA.
7. Press ▲or ▼until the first character of the password is displayed.
8. Press ▶ to accept this character and select the next character.
9. Repeat the process to enter the remaining password characters, WMFZJJP.
10. Press ◀ to enter the password and return to the default menu display.
    The controller pair setup is complete.

## Installing Command View EVA

Command View EVA is installed on the HP OpenView Storage Management Appliance and runs in the OpenView environment. Installation may be skipped if the latest version of Command View EVA is running on the storage management appliance. Verify the latest version at the HP web site: http://.h18006.www1.hp.com/storage/software.html.

To install a new version, locate the management appliance update CD-ROM and the associated documentation that was shipped with your storage system. Refer to Additional Documentation. Follow the instructions in the *HP OpenView Storage Management Appliance Update Installation Card* to install the new software.

You will also need a supported browser on the same network as the storage management appliance. This network can be anything from a LAN to the Internet. Th documentation that comes with the update CD-ROM contains information on supported browser versions.

When the new software is installed, follow the CD-ROM documentation to get to the OpenView Storage Management Appliance, the launching point for Command View EVA. Follow the instructions in the OpenView Storage Management Appliance online help to navigate to and launch Command View EVA.

## Installing Optional EVA Software Licenses

If you purchased optional EVA software, it will be necessary to install the license. Optional software available for the Enterprise Virtual Array 3000 includes Business Copy EVA and Continuous Access EVA. Refer to the documentation included with the software for instructions on installing the license.

# System shutdown and powerup

The Enterprise storage system is shut down using Command View EVA. Shutdown with Command View EVA performs the following functions:

- Flushes cache
- Removes power from the controllers
- Disables cache battery power
- Removes power from the drive enclosures
- Disconnects the system from Command View EVA

**NOTE:**

The storage system may take a long time to complete the necessary cache flush during controller shutdown when snapshots are being used. The delay may be particularly long if multiple child snapshots are used, or if there has been a large amount of write activity to the snapshot source Vdisk.

To shut the entire system down, perform the following steps:

1. Launch Command View EVA. Click the **HSV Storage Network** icon to discover the storage systems to ensure they are presented.
2. In the Navigation pane, click the name of the storage system to access the **Initialized Storage System Properties** page (similar to the screen shown in Figure 13).

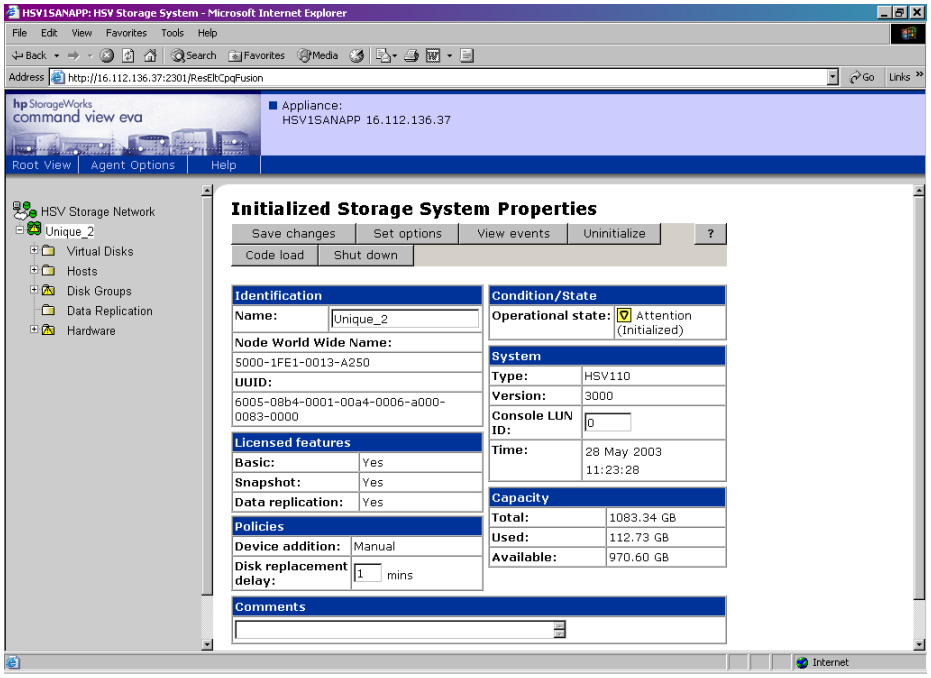



**Figure 13 Initialized Storage System Properties page**

3. Click **Shut down** at the top of the Content pane. A screen similar to the one shown in Figure 14 displays.

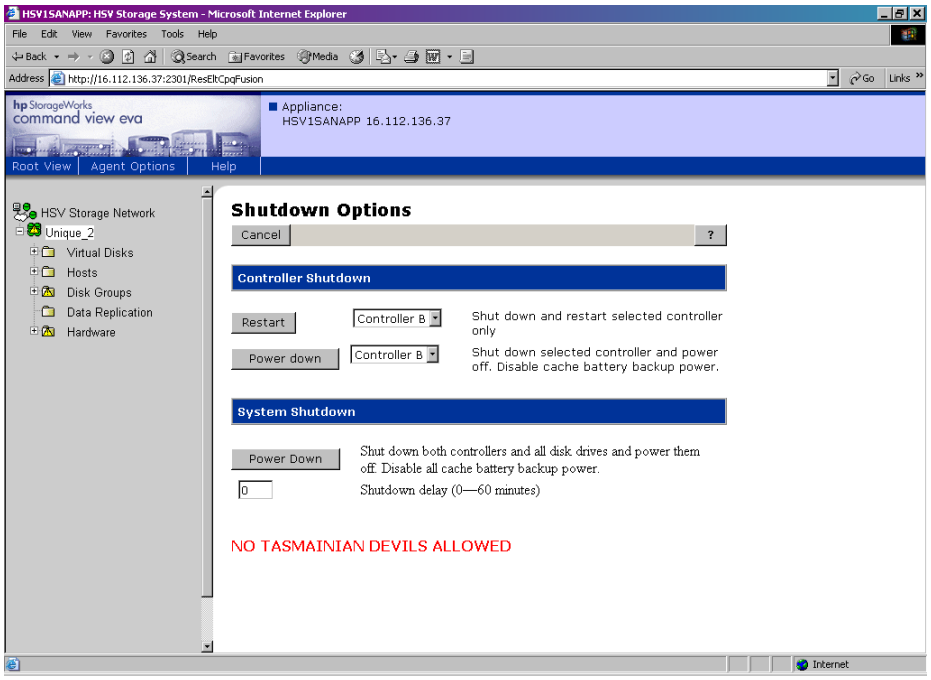



**Figure 14 Shutdown Options page**

4. In the **System Shutdown** section of the Content pane, click **Power Down** to achieve the effect described to the right of the button. If a delayed shutdown is desired, enter a value in the **Shutdown delay** box to set a time delay (in minutes) to preface system shutdown initiation.

   Wait for the shutdown to complete before proceeding. The HSV controllers will perform an orderly shutdown and then power off.

5. Turn off the power switch on the rear of each HSV controller.

6. Turn off the circuit breakers on both of the EVA rack Power Distribution Units (PDU).
7. If the SMA is not being used to manage other storage devices, shut don the SMA.
    1. Log into the SMA using the web interface.
    2. Click on **Settings > Maintenance > Shutdown**.

To power up a storage system, perform the following steps:

1. Verify that each fabric Fibre Channel switch to which the HSV controllers are connected is powered up and fully booted. The LED power indicator on each switch should be on.

    If you must power up the SAN switches, wait for them to complete their power-on boot process before proceeding. This may take several minutes.
2. If the SMA was previously shutdown, power it on and wait for it to completely boot. Verify the SMA is running by logging into it using the web interface.

    .

NOTE:

Before applying power to the rack, ensure that the power switch on each HSV controller is off.

3. Power on the circuit breakers on both EVA rack PDUs.

    Verify that all drive enclosures are operating properly. The status indicator and the power indicator should be on (green).
4. Wait three minutes and then verify that all disk drives are ready. The drive ready indicator and the drive on-line indicator should be on (green).
5. Power on the upper HSV controller. It will assume the roll of master controller.
6. Wait 10 seconds and then power on the lower controller. It will assume the roll of slave controller.
7. Verify that the (Operator Control Panel) OCP display on each controller displays the storage system name and the EVA WWID.
8. Launch Command View EVA and verify connection to the storage system. If the storage system is not visible, click the HSV Storage Network icon in the Navigation pane to discover the recently restarted storage system.

NOTE:

If the storage system is still not seen, it may be necessary to reboot the SMA to re-establish the communication link.

9. Check the array status using Command View EVA to ensure everything is operating properly. If any status indicator is not normal, check the log files or contact your HP service provider for assistance.

# 3 Command View EVA

This chapter provides information about operating Command View EVA.

## Introduction to Command View EVA

Command View EVA is the application used to manage and monitor an Enterprise Virtual Array. Command View EVA is launched from the Storage Management Appliance Software interface. Figure 2 illustrates how Command View fits into the storage system environment.

The Command View EVA software is installed on an HP OpenView Storage Management Appliance and runs in the environment provided by the HP OpenView Storage Management Appliance software. When installed on the management appliance, which communicates with the storage system. A standard Web browser serves as the client for the management agent.

## Launching Command View EVA

To access Command View EVA, browse to the Storage Management Appliance and log in. The Storage Management Appliance Home page displays, as shown in Figure 15.

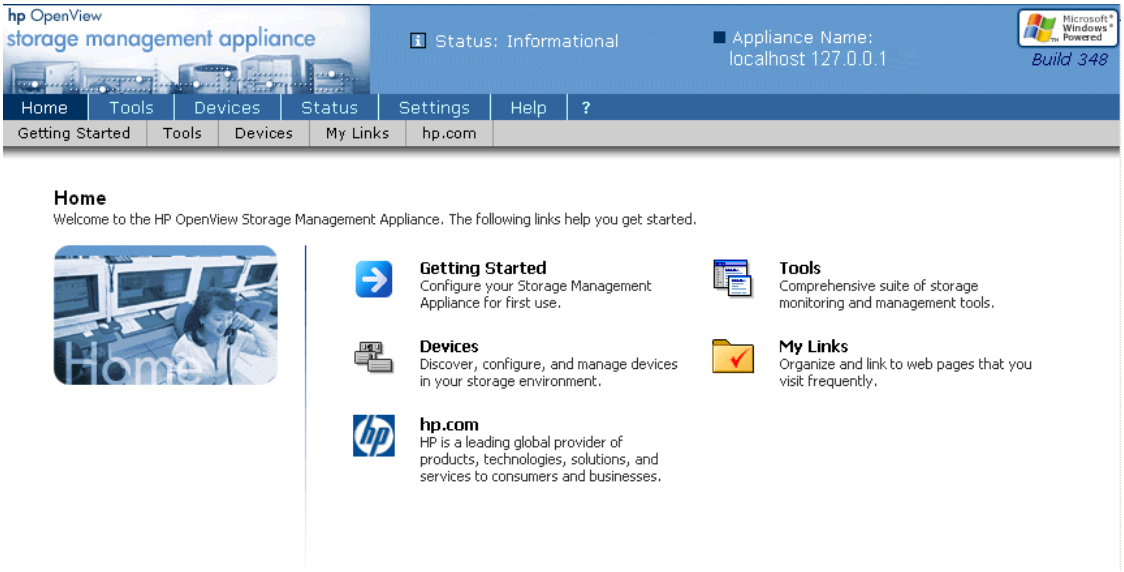



**Figure 15 OpenView Storage Management Appliance home page**

To launch Command View EVA, use one of the following methods:

- SelectDevices from the list of options in the Content pane (see Figure 15). The Devices page displays. Select **command view eva**.
- From the menu bar of the Home page, select **Devices > command view eva**.

Command View EVA launches in a new window as shown in Figure 16.

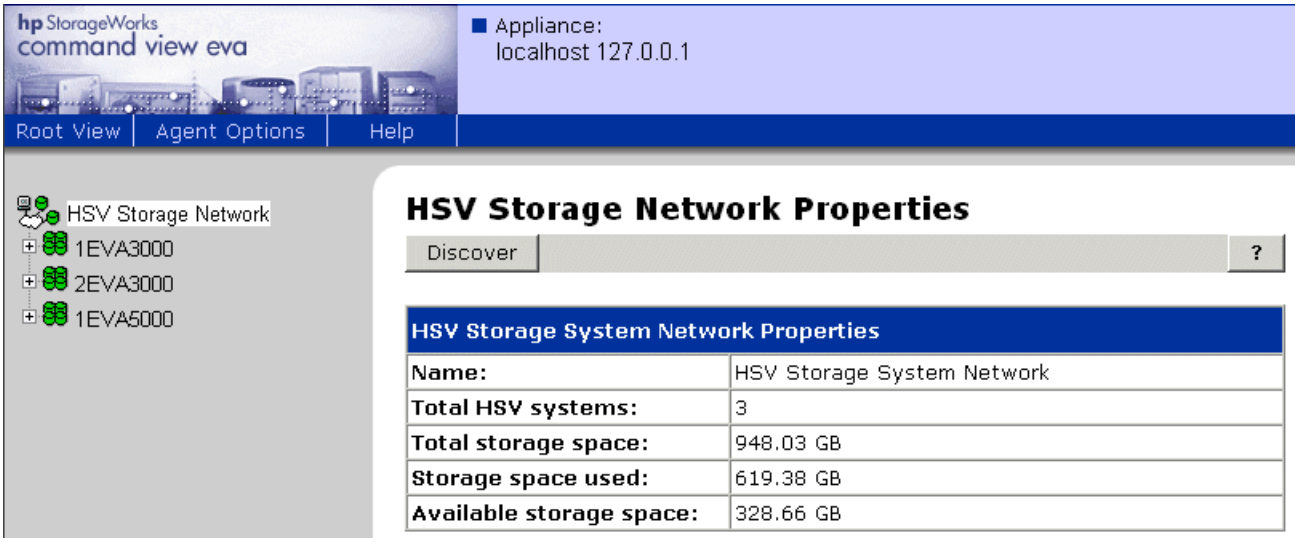



**Figure 16 HSV Storage Network Properties page**

NOTE:

If an uninitialized storage system is selected in the Navigation pane, a **View Events** button appears to the right of the **Discover** button in the Content pane of the HSV Storage Network Properties display. Procedures for initializing an uninitialized storage system are found in the *HP StorageWorks Command View EVA Getting Started Guide*.

# Organization of the interface window

The Command View EVA user interface is organized like the Storage Management Appliance interface. There are three panes in the window, as shown in Figure 3:

- Session pane
- Navigation pane
- Content pane

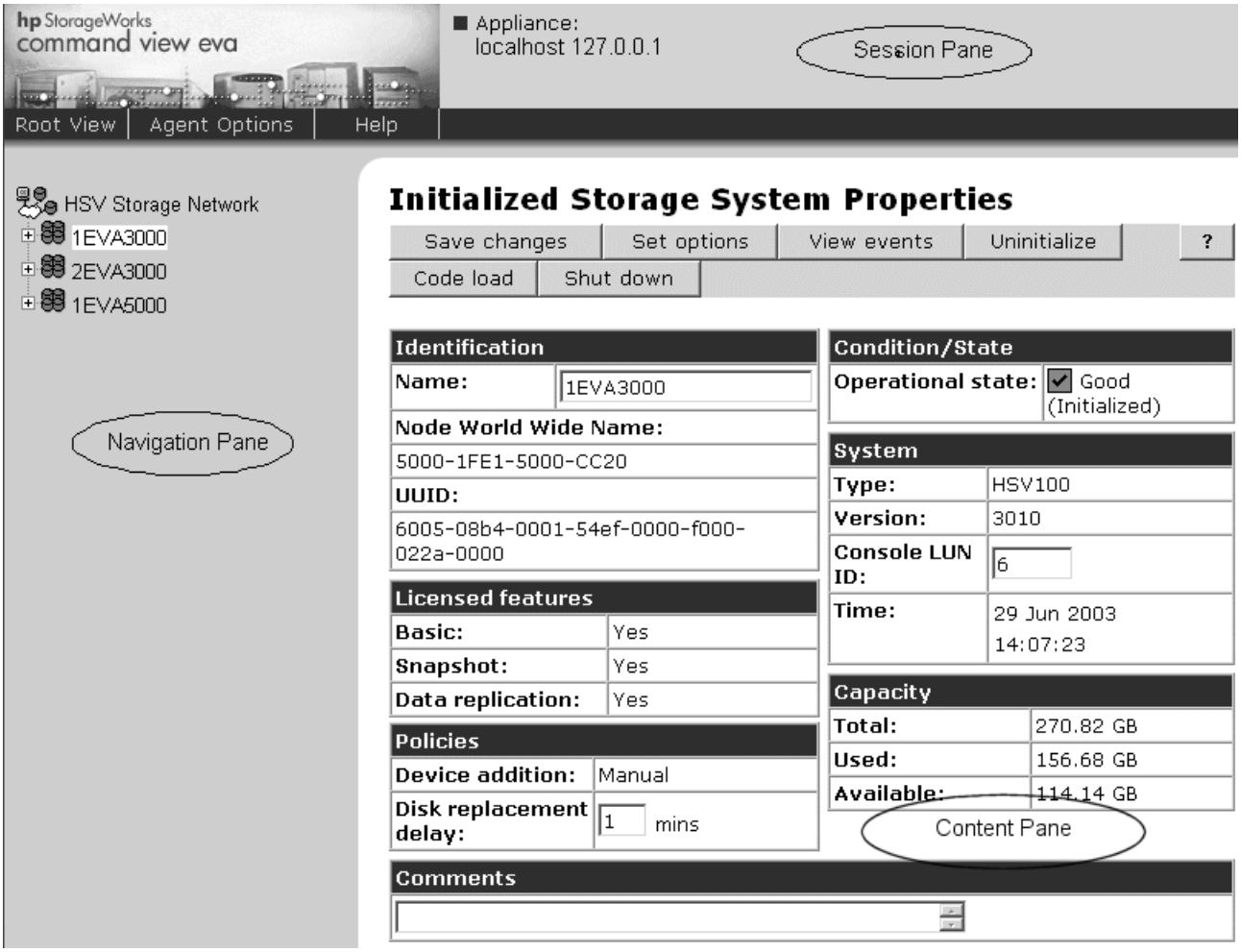



**Figure 17 The three panes of the interface window**

NOTE:

The basic license for VCS software is no longer required; however, it is still reflected in the Initialized Storage System Properties window and is always shown as Yes.

## The Session pane

The Session pane, shown in Figure 18, displays information about the specific management agent you are using:

- The StorageWorks software component you are using (Command View EVA).
- The name and IP address of the Storage Management Appliance that is running the management agent you are using.
- Buttons that control management agent operations. They are:
  - Root View–displays the HSV Storage Network Properties page
  - Agent Options–selects interface and agent options
  - Help–displays online help in a new window




**Figure 18 The Session pane**

## The Navigation pane

The Navigation pane, shown in Figure 19, is a hierarchy of folders that organize components that represent the logical structure of the storage system. These logical structures, which are examined further in Controlling and Monitoring Storage System Components, are:

- Virtual disks
- Hosts
- Disk Groups
- Data Replication
- Hardware

**NOTE:**

Multiple storage systems can be controlled and displayed under the HSV Storage Network.

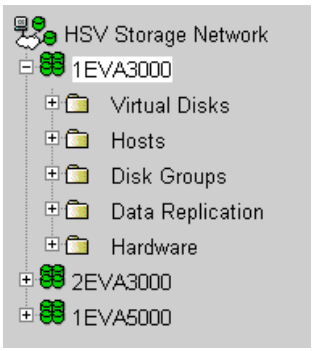



**Figure 19 The Navigation pane**

### Adding a folder

The initial folder structure is simple, but you can add layers of subfolders to customize the organization of Vdisks and hosts. For example, to group a number of hosts into a category, click on the top-level host folder and add a subfolder in which to group those hosts. Then move your hosts into the subfolder.

**NOTE:**

Folders may be created only within the Virtual Disks and Hosts folders.

### Navigating through folders

You can "drill down" into any folder for more specific information. For example, to locate information on a specific virtual disk, start at the top-level virtual disk folder and click on the subfolders until you locate the virtual disk in question.

**NOTE:**

Click a folder's + symbol to expand it without updating the Content pane for quicker access to subcomponents.

## The Content pane

The Content pane, shown in Figure 20, displays information on the object you selected in the Navigation pane and presents control actions you can perform.

The ? button, which is in the upper right corner of the Content pane, displays help for that page. Additional ? buttons that provide field-level help also exist within the Content pane.

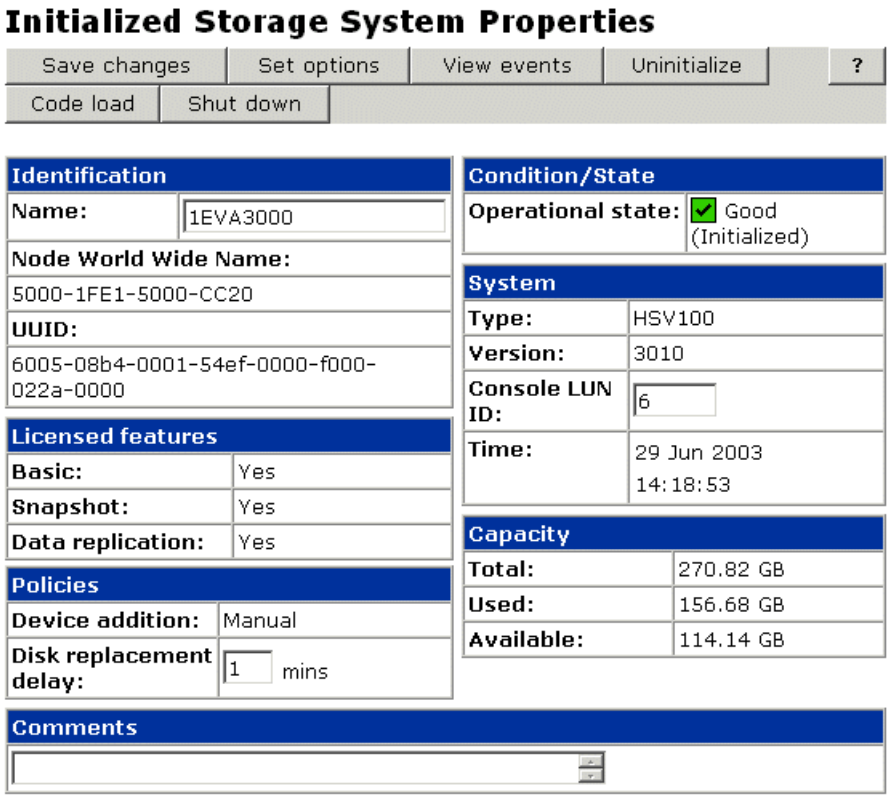



**Figure 20 The Content pane**

# Setting storage management agent options

Command View EVA is a storage management agent. Management agent options are settings that affect the actions, attributes, and appearance of the management agent. To access the option pages, click the Agent Options button on the Session pane, as shown in Figure 21.




**Figure 21 Agent Options button on the Session pane**

The agent options available are shown in Table 4.

**Table 4 Agent options**

| Options | Description |
|---|---|
| Discover storage systems | Instructs the management agent to look for new storage systems on the fabric. |
| Storage system password access | Establishes a password interlock between the management agent and individual storage systems. |
| Remote access password options | Displays the Remote Access Password Options page. Allows the user to view and manage access information so applications on the Storage Management Appliance can communicate with applications on remote systems. |
| Licensing options | Adds or displays software license keys. |
| User interface options | Establishes how the interface displays and operates. |
| Page footer message options | Allows you to set a message that will appear at the bottom of each Content pane page. |

For more information on a specific option, log in to Command View EVA and click the ? button on the page for that option.

# Setting system options

Command View EVA allows you to configure the management agent system options from the System Options page (see Figure 22). To access the System Options page, click an initialized storage system in the Navigation pane, then click **Set Options** on the Initialized Storage System Properties page.

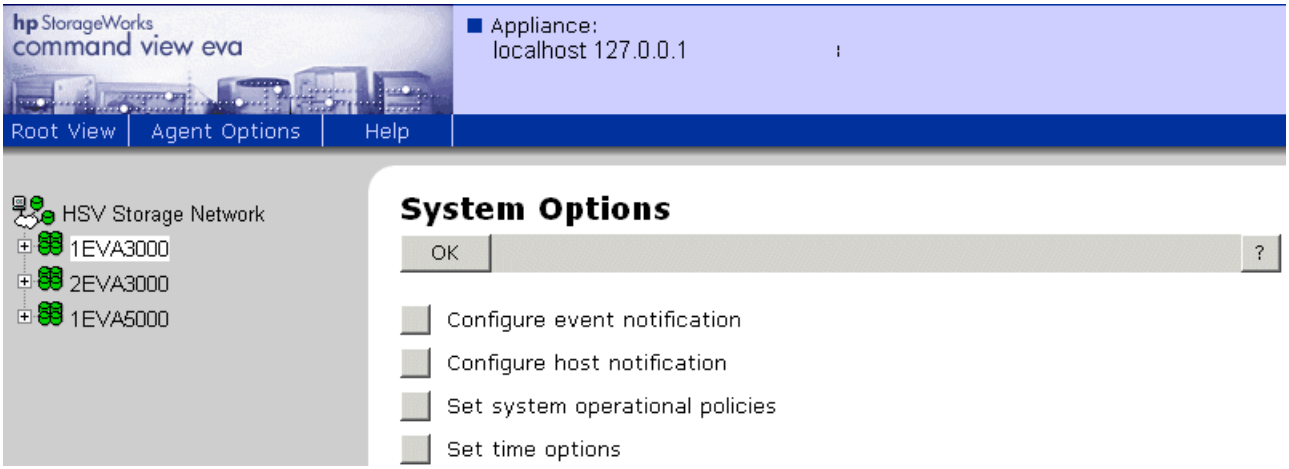



**Figure 22 Options buttons on the System Options page**

The options available to the user on the System Options page are described in Table 5.

**Table 5 System options**

| Options | Description |
|---|---|
| Configure event notification | Configures which events generate SNMP trap notifications. |
| Configure host notification | Allows user to modify or add new host entries to which the SNMP trap notifications will be sent. |
| Set system operational policies | Provides option to set policy for the disk drives to be added to a disk group manually or automatically. |
| Set time options | Provides options for setting storage system time. |

For more information on a system option, log in to Command View EVA and click the ? button on the System Options page.

# Storage system managed by another management agent

A management agent can control multiple storage systems and multiple management agents can also control a single storage system. However, **only one agent is allowed to manage one system at a time**. Password protection controls management agent access to storage systems. When multiple management agents reside on the same fabric, without password protection, any management agent on the fabric could access any storage systems on the fabric.

The display shown in Figure 23, appears if anothr management agent is detected. Follow the instructions displayed.

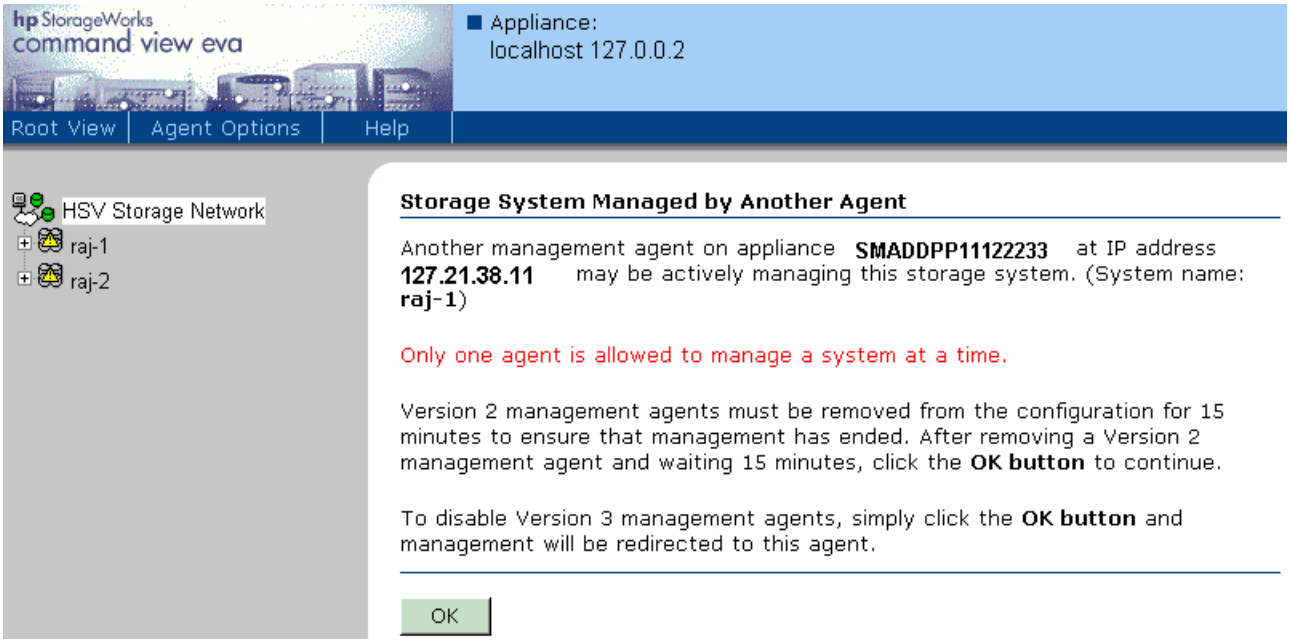



**Figure 23 Storage system managed by another agent**

# Controlling and monitoring storage system components

This section discusses controlling and monitoring storage system components. The components controlled using Command View EVA are:

- Virtual Disks
- Hosts
- Disk Groups
- Data Replication Groups
- Hardware

All of these components are accessible using the folders in the Navigation pane, as shown in Figure 24.

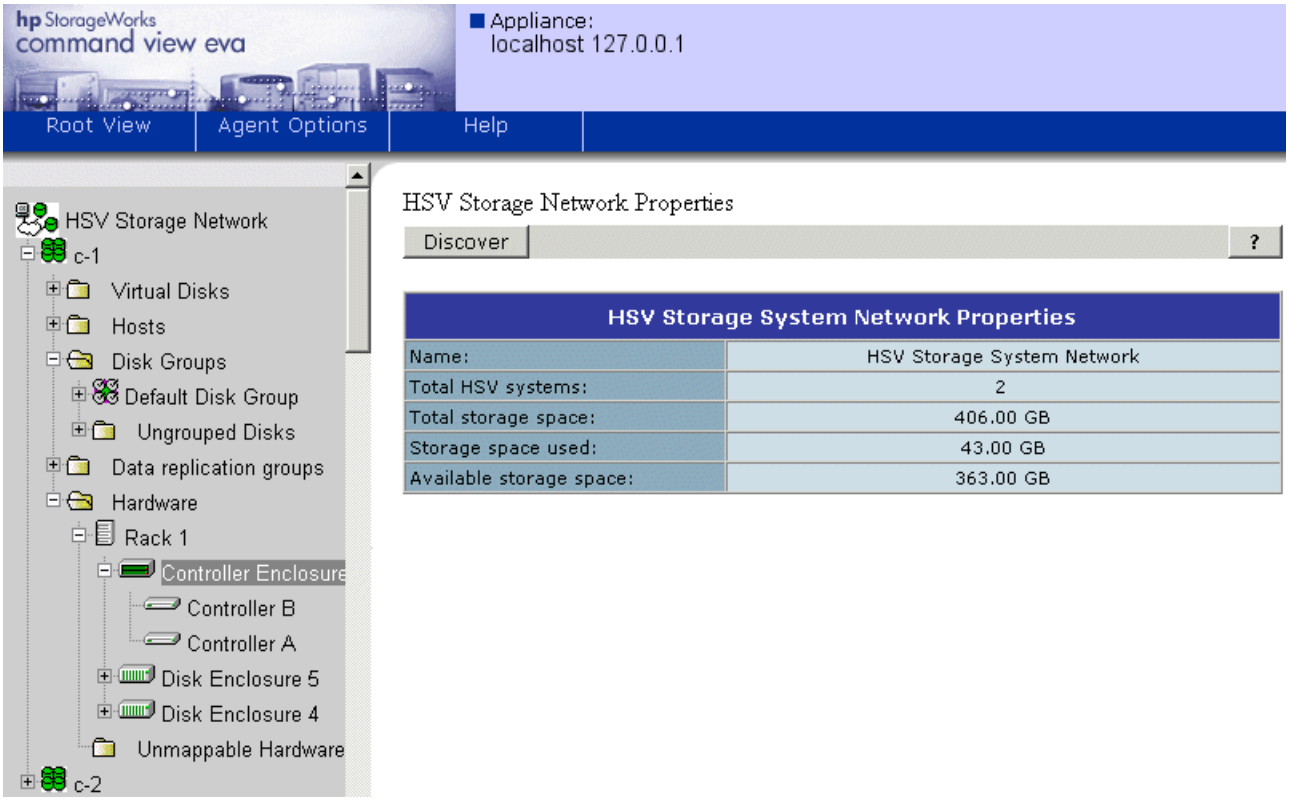



**Figure 24 Storage system components**

## Virtual disks

A virtual disk (Vdisk) is a virtualized disk drive created by the controllers as storage for one or more hosts. Virtual disk characteristics provide a specific combination of capacity, availability, performance, and accessibility. The controller pair manages virtual disk characteristics within the disk group specified for the virtual disk.

The host computer sees the virtual disk exactly like it would see a physical disk with the same characteristics.

**NOTE:**

The maximum number of virtual disks is 512. One virtual disk can be presented to multiple hosts. The maximum size of a virtual disk is 2047 GB. The maximum number of presentations is 8192.

There are three types of virtual disks:

- Active member of a virtual disk family—A virtual disk that is accessed by one or more hosts for storage. An active member of a virtual disk family is automatically created whenever a new virtual disk family is created. An active virtual disk member and its snapshots, if one or more exist, constitute a virtual disk family.
- Snapshot virtual disk—A virtual disk that reflects the contents of another virtual disk at a particular point in time. A snapshot operation can be done only to an active member of a virtual disk family. The active virtual disk member and its snapshots constitute a virtual disk family. A snapshot is intended to be temporary.

**NOTE:**

A maximum of seven snapshots per virtual disk can exist at one time.

- Virtual disk Snapclone—A Virtually Instantaneous Snapclone is a virtual disk that is an exact copy of another virtual disk at a particular point in time. Only an active member of a virtual disk family can be snapcloned. The snapclone, like a snapshot, reflects the contnts of the source virtual disk at a particular point in time. Unlike the snapshot, the snapclone is an actual clone of the source virtual disk and becomes an independent active virtual disk member of its own disk family when all the data is replicated. A snapclone can be presented to hosts and used for storage while the data is replicating.

Within the Virtual Disks folder in the Navigation pane are Vdisk families. You can click on any one of the Vdisk families within the virtual disk folder to see the properties page for a specific Vdisk family.

The Virtual Disks folder is accessible using the folder structure in the Navigation pane, as shown in Figure 25.

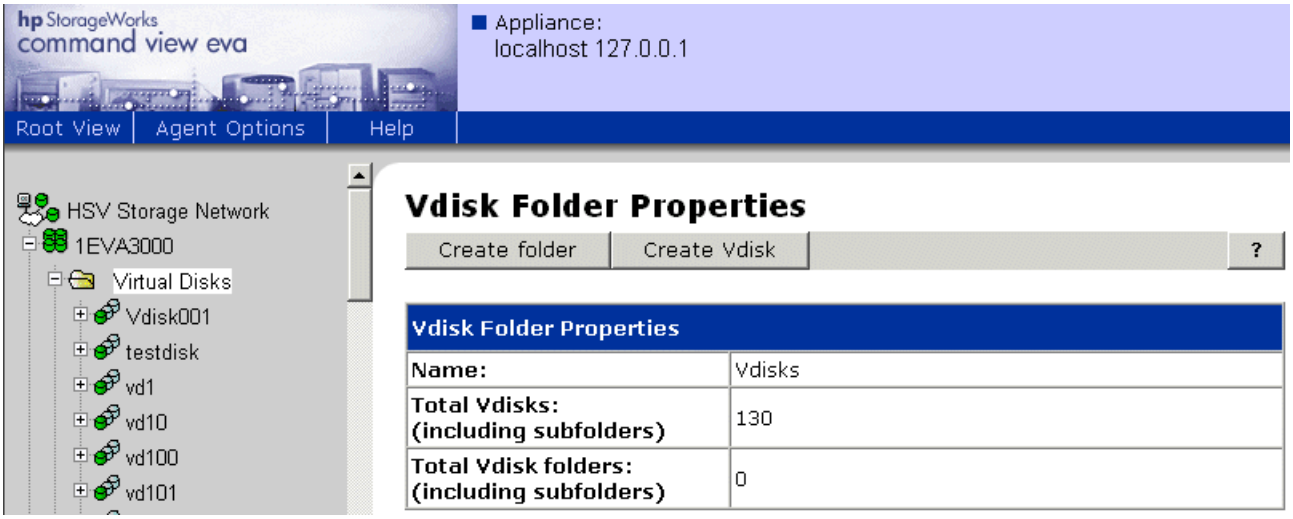



**Figure 25 Virtual Disk folder**

## Virtual RAID considerations

Virtual RAID helps determine the level to which user data is protected—VraidX, where *X* can be 0, 1, or 5. Redundancy is directly proportional to cost in terms of storage usage—the greater the level of data protection, the more storage space is required. There are three types of redundancy available in the Enterprise Virtual Array:

- Vraid0—No failure tolerance of data is provided.
- Vraid1—All data is duplicated within the storage system. This is the highest level of storage use with the lowest amount of read/write overhead.
- Vraid5—All data is protected by parity. This is the lowest level of storage use while maintaining redundancy, at a cost of a higher amount of read/write overhead.

## Presenting a host

A host can be selected for presentation (that is, a virtual disk made available to a host). Two choices exist:

- Select a host for presentation—Indicates that the host can use the virtual disk for data storage. The host will see the virtual disk at the next available LUN.
- Select a host and LUN for presentation—Indicates that the host can use this virtual disk for data storage. The host will see the virtual disk at the specified LUN.

# Hosts

A host is a computer that operates applications relative to a storage system. A host uses one or more virtual disks created and presented by the controller pair. Each host connects to the fabric through one or more Fibre Channel Adapters (FCAs). An FCA is a hardware and firmware device that enables a host coputer to use the Fibre Channel transmission protocol. Each Fibre Channel port on a host adapter has a World Wide Name (WWN). Typically, the host operating system reports the WWNs of all FCA ports in the host. The WWN also appears on a sticker on the FCA board.

The Host folder is accessible using the folder structure in the Navigation pane, as shown in Figure 26.

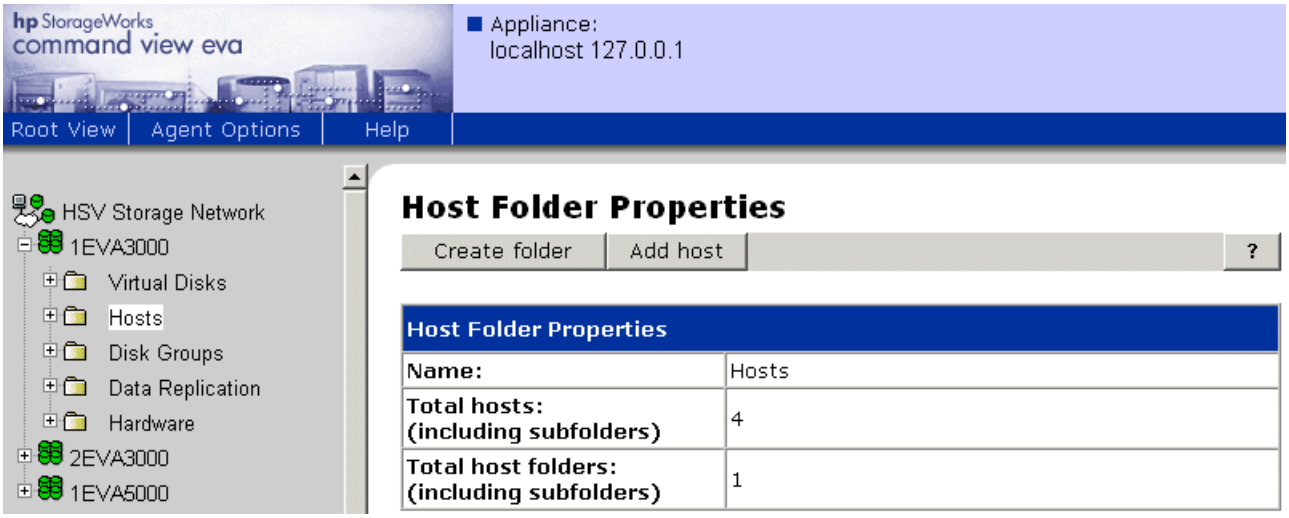



**Figure 26 Host folder**

Properties of individual hosts are accessed by selecting a specific host within the hosts folder. Selecting a host displays the Host Properties window, as shown in Figure 27.

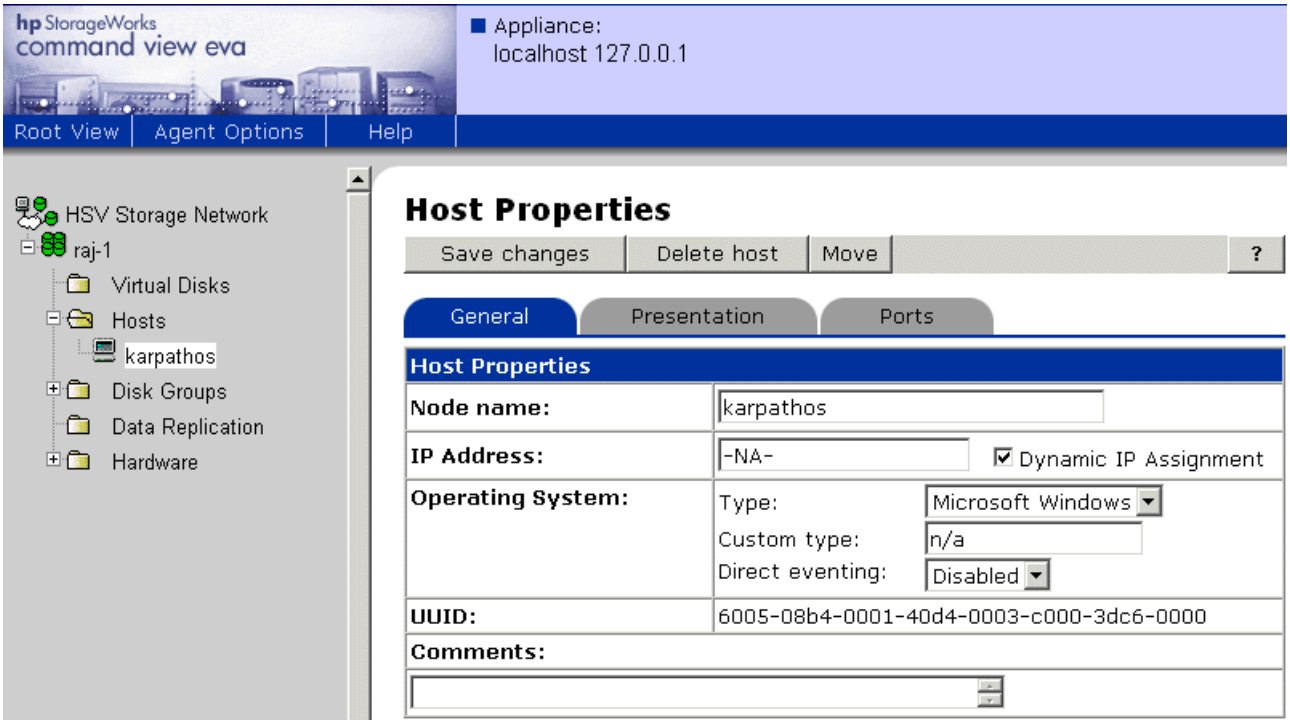



**Figure 27 Host Properties page**

## Adding a host

Before a host can use the storage system's virtual disks, the host must be known to the storage system. This process is called "adding a host." Adding a host creates a path from the storage system to one host FCA port. Additional host FCA ports can be specified as a modification to the host properties.

## Deleting a host

Deleting a host removes it from the list of hosts that the storage system maintains. You cannot delete a host if there are any virtual disks presented to it.

## Modifying a host

The following actions are available on the Host Properties page **General** tab:

- Change the node name.
- Change the IP address.
- Change the operating system type.
- Move the host from its current folder to a different one.
- Enable or disable direct eventing.
- Delete a host.

**NOTE:**

The only changes that you can perform on an existing host are shown above. To specify any other property characteristics, you must delete the host, then add it again.

## Using the Presentation tab

Selecting the **Presentation** tab generates a display showing the Vdisks that have been presented to the selected host.

## Working with ports

The options available from the Host Properties page **Ports** tab let you add or delete adapter ports. To add a port:

1. Click **Add Port** on the **Ports** tab.
2. Select a World Wide Name from the drop-down list on the Add a Host Port page or enter the host port WWID mnually.
3. Click **Add Port**.

# Disk groups

A disk group is the set of physical disk drives in which a virtual disk is created. The physical disk is a disk drive that plugs into a drive bay and communicates with the controllers through the device-side Fibre Channel loops. Only the controllers can communicate directly with the physical disks.

Collectively, the physical disks are called the array and constitute the storage pool from which the controllers create virtual disks. One controller pair can support up to 240 physical disks.

The following information is true about disk groups:

- Each physical disk drive belongs to only one disk group.
- Multiple virtual disks can be created in one disk group, up to the disk group's capacity.
- Each virtual disk exists entirely within one disk group.
- A disk group can contain all the physical disk drives in a controller pair's array or it may contain a subset of the array.
- The minimum number of disks in a disk group is eight.

One disk group (the Default Disk Group) is created when the system is initialized. Disk groups can be added, as needed, up to a maximum of 16.

The Default Disk Group is accessible using the folder structure in the Navigation pane, as shown in Figure 28.

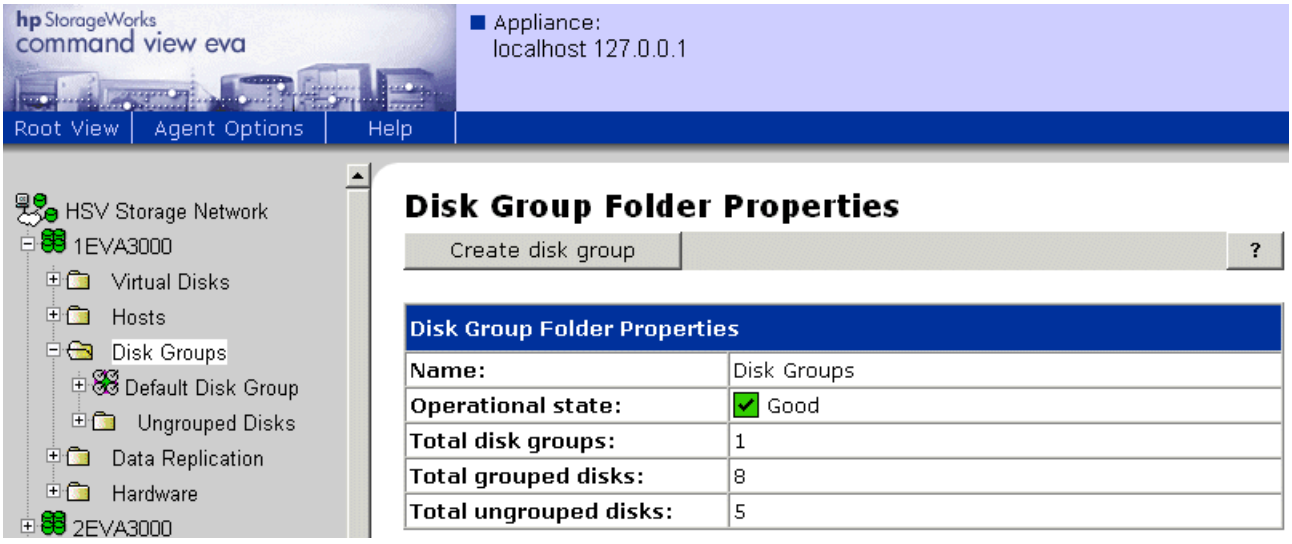



**Figure 28 Top level disk group**

Selecting a disk group within the Disk Groups folder in the Navigation pane displays the Disk Group Properties page, as shown in Figure 29.

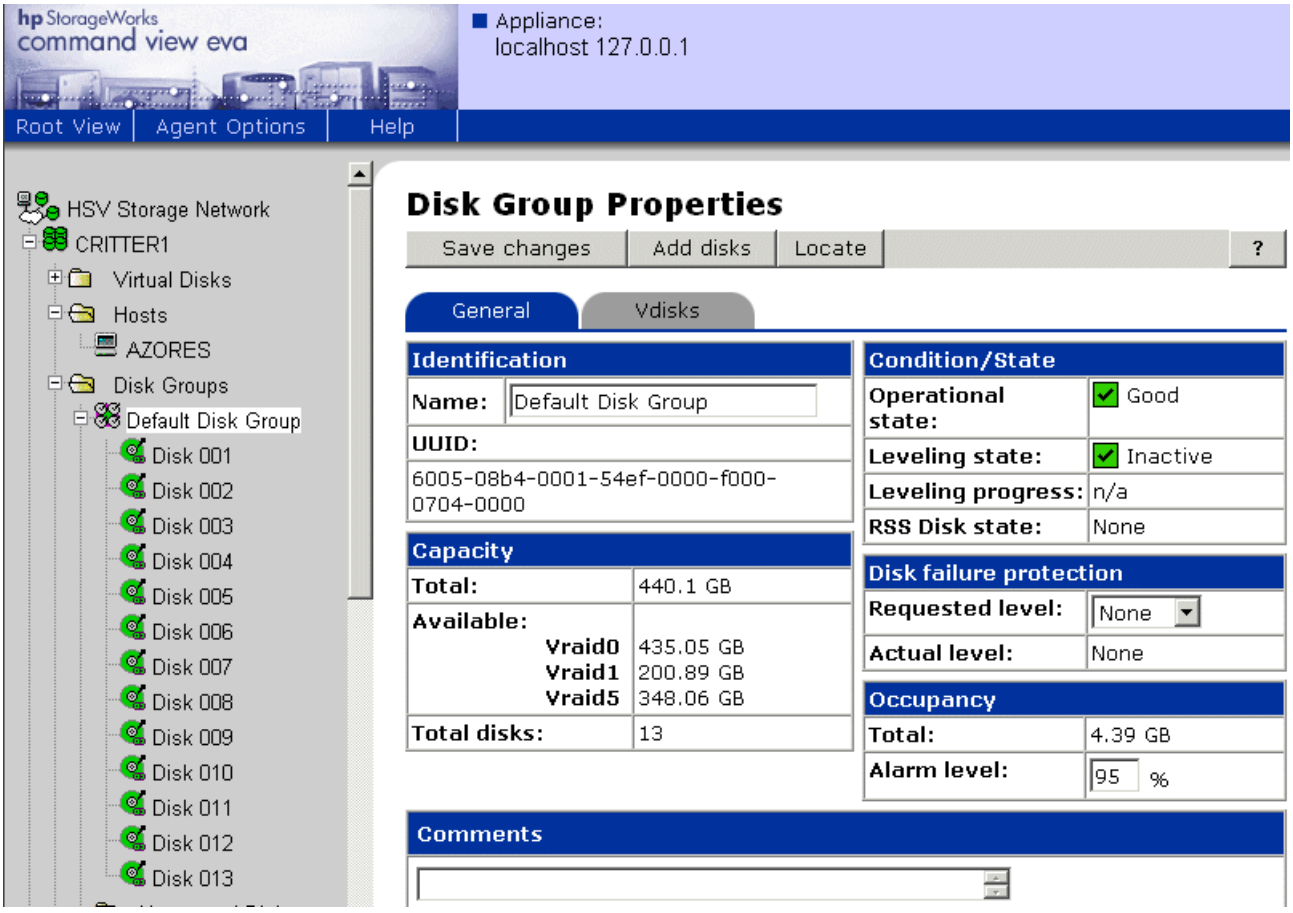



**Figure 29 Disk Group Properties page**

## Working with disk groups

The operations you can perform on a disk group are:

- Creating a disk group—Combines physical disk drives into one disk group. The system automatically selects drives based on their physical locations.
- Modifying a disk group—Changes disk group properties, including the disk failure protection level, occupancy alarm level, disk group name, or comments.
- Adding a new disk to a disk group—Adds a new physical disk to a disk group.
- Deleting a disk group—Deleting a disk group consists of freeing all physical drives contained in that disk group.
- Locating a disk group—Causes an LEDto light up, allowing you to identify the physical drives that make up the disk group.
- Ungrouping a disk—Removes a disk from a disk group.

**NOTE:**

The disk is not deleted from the disk group but is actually "ungrouped." If the disk is to be removed from the rack, use the locate function so that it can be physically identified in the rack before it is ungrouped.

You cannot delete the only disk group (such as the default disk group). The **Delete** button is not visible if only one disk group is present.

For more information about disk drives, see Fibre Channel Disk Drives.

## Data replication

Command View EVA provides host-independent data replication across two or more Enterprise Virtual Arrays. The storage systems can be located at the same physical site or different physical sites. When the storage systems are located at different sites, Command View EVA provides a disaster-tolerant storage and data replication solution.

Command View EVA manages data replication functions by organizing Vdisks into Data Replication (DR) groups. DR groups allow you to manage the replication of a set of Vdisks. The Data Replication folder is accessible using the folder structure in the Navigation pane, as shown in Figure 30.

You can perform the following data replication tasks:

- Add a Vdisk to a DR group—Add the selected destination Vdisk family to the DR group.
- Create a DR group—Create up to 128 DR groups in a storage system.
- Fail over a DR group—When a failure occurs in your source storage system, data fails over to the destination storage system to allow continued access.
- Modify a DR group—Modify the name and failsafe properties of a DR group.
- Delete a DR group—Delete a DR group from a source storage system.

For detailed information on the use of Command View EVA data replication functions, refer to the Command View EVA online help.

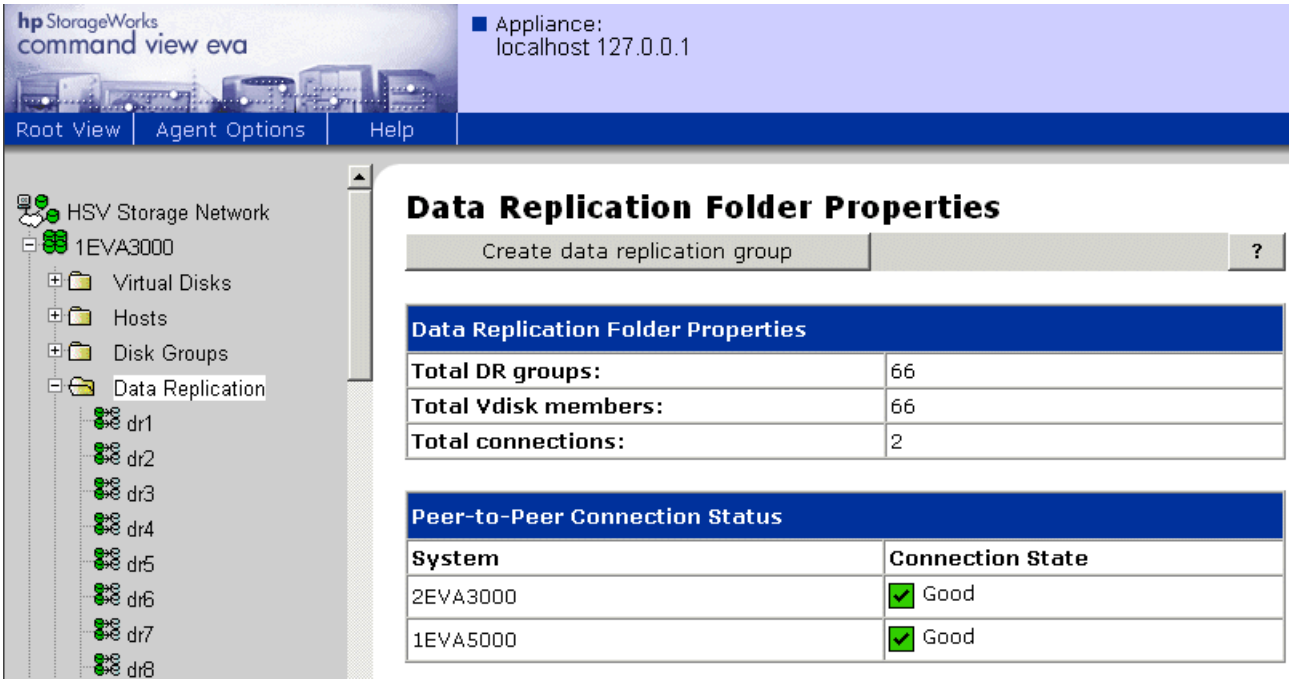



**Figure 30 Data Replication folder**

## Hardware

The hardware folders provide a view into the operation of various physical components of the storage system:

- Rack—A floor-standing structure primarily designed for, and capable of, holding and supporting storage system equipment.
- Controller—A hardware and firmware device that manages communications between host systems and other devices.
- Enclosures
  - Drive enclosure—Contains up to 14 physical disk drives and their supporting structures.
  - Controller enclosure—A unit that holds one or more controllers, power supplies, blowers, cache batteries, transceivers, and connectors.
- Physical Disk Drives—Disk drives that plug into a drive enclosure bay and communicate with the controllers through device-side Fibre Channel loops.

**NOTE:**

The FC loop switches are not displayed by Command View EVA.

The Hardware folder is accessible using the folder structure in the Navigation pane, as shown in Figure 31.




**Figure 31 Hardware folder**

## Racks

The rack "container" is located within the Hardware folder and is accessible using the folder structure in the Navigation pane, as shown in Figure 32. Each container displays the objects located in that rack. One rack container exists for each rack connected to the storage environment.

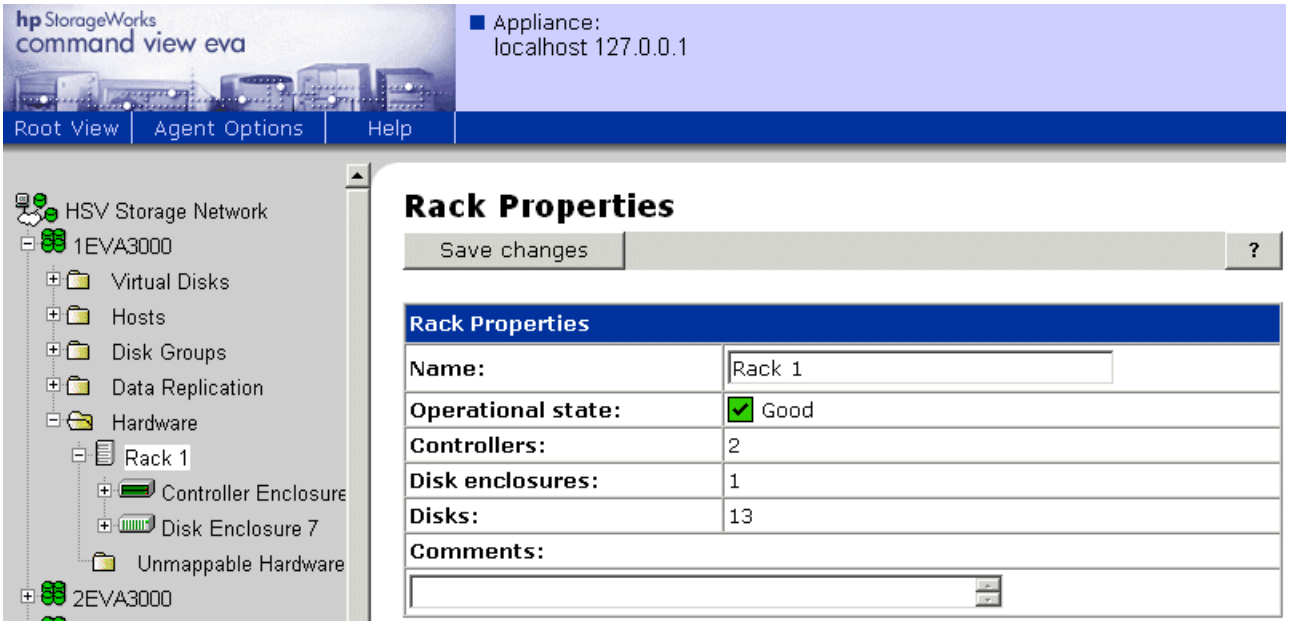



**Figure 32 Rack container**

For more information about racks, see Racks.

## Controllers

Each storage system has a pair of controllers. The controller properties can be viewed by expanding the Controller Enclosure icon, then selecting the desired controller. The following properties are available for each controller:

- General—Identifies the general properties of the controller. These properties include identification, condition and state, cache memory, and location information.
- Host Ports—Identifies the WWN, operational state, speed, and switch connection for each host port.
- Device Ports—Identifies the WWN, loop ID, and operational state for each loop pair.
- Enclosure—Identifies the location, blowers, power, temperature and cache battery system information.

The controller enclosure and controller objects are accessible using the folder structure in the Navigation pane, as shown in Figure 33.

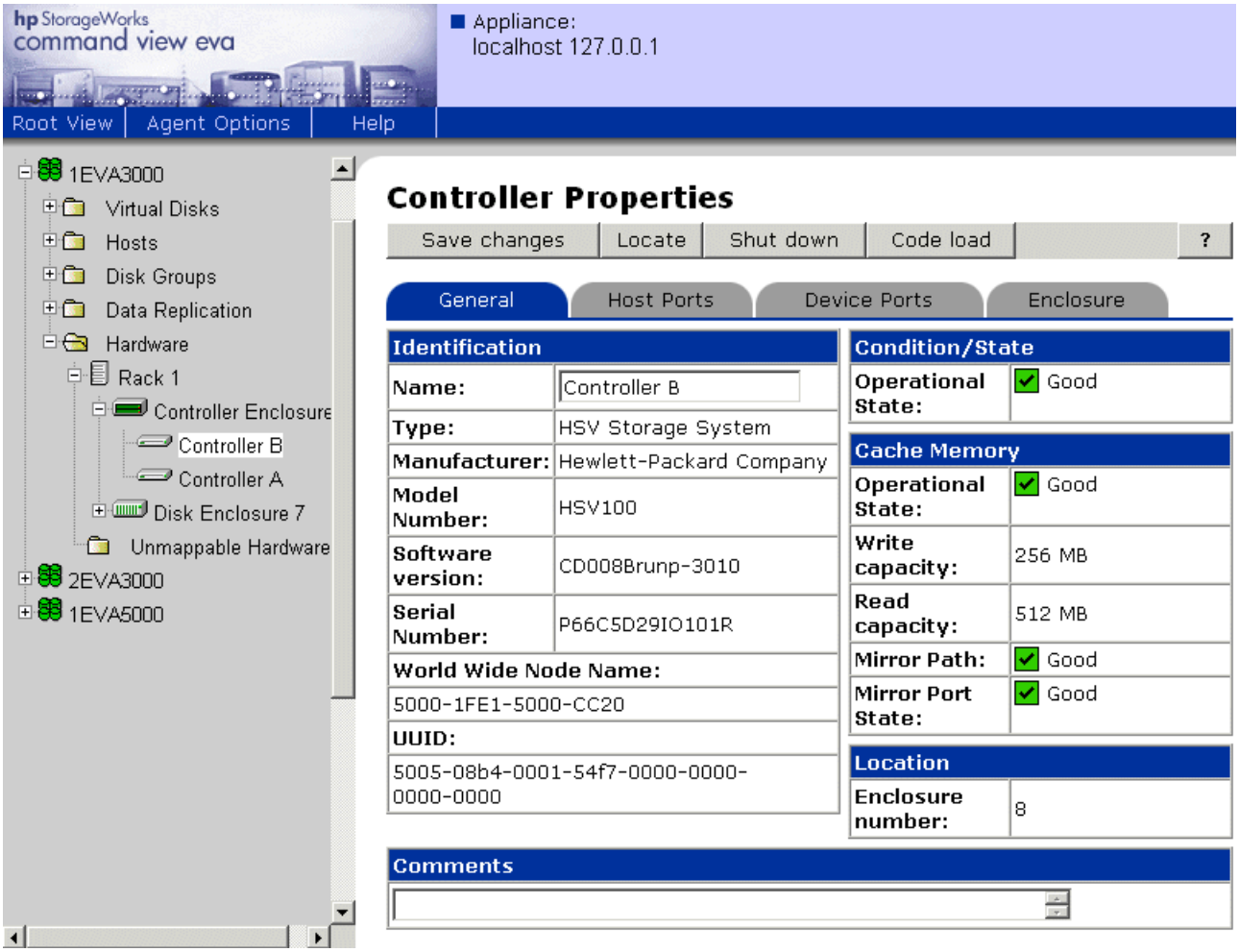



**Figure 33 Controller folder**

For more information about controllers, see HSV110 controllers.

## Enclosures

Two types of hardware enclosures exist for the Enterprise Virtual Array, disk enclosures and controller enclosures.

- Disk enclosure—A disk enclosure contains up to 14 physical disk drives and their supporting structures. Each of the vertical positions in the enclosure where the disk drive is located is called a bay. The bays are numbered sequentially in decimal numbers, starting at the left when you are facing the front of the rack.
- Controller enclosure—A controller enclosure is the mechanical enclosure that protects the controller circuit board and it associated components for a controller pair. Except for the cache batteries and blower assemblies, all components in the controller enclosure are considered one assembly and must not be separated.

The disk enclosure object is accessible using the folder structure in the Navigation pane, as shown in Figure 34.

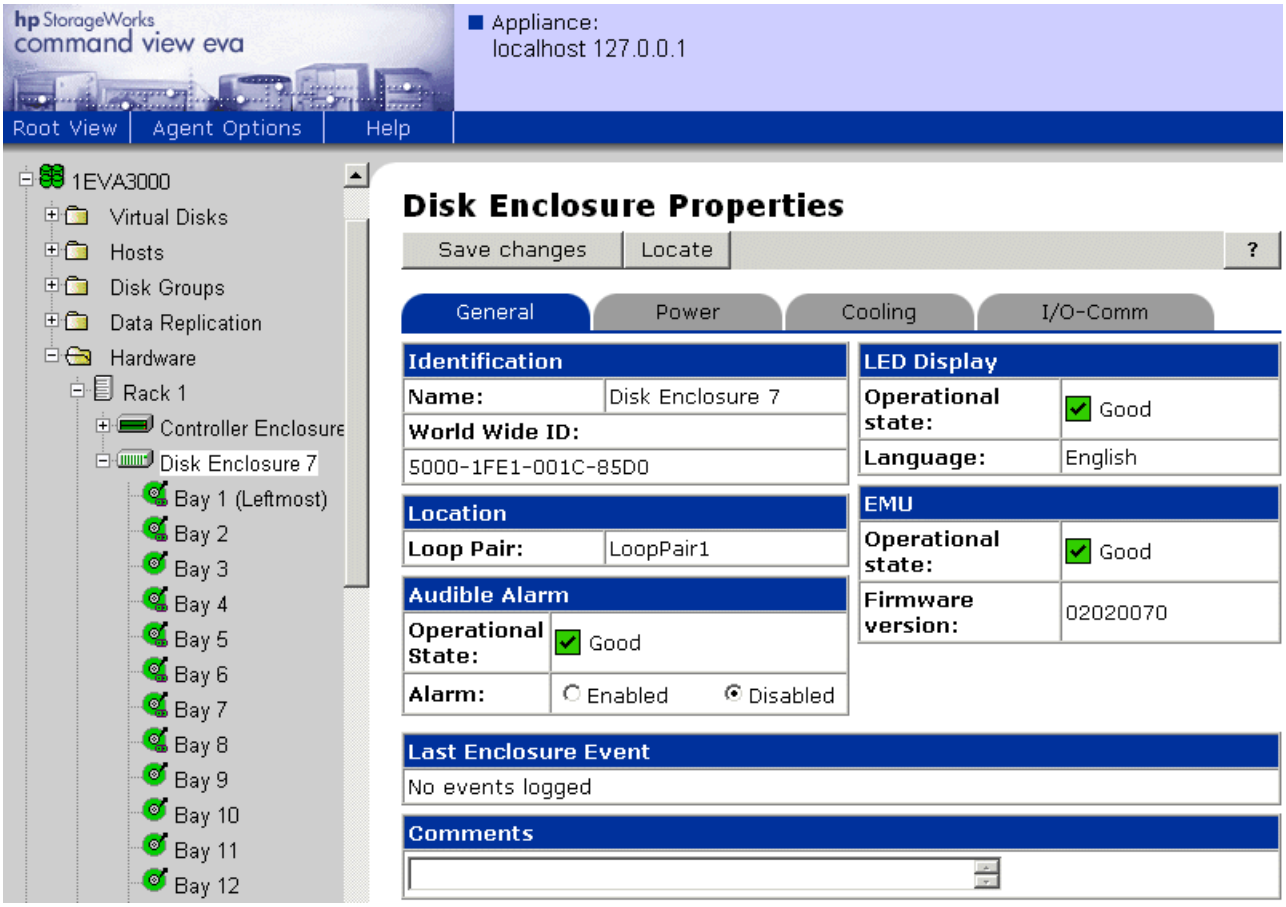



**Figure 34 Disk enclosure folder**

The controller enclosure object is accessible using the folder structure in the Navigation pane, as shown in Figure 35.

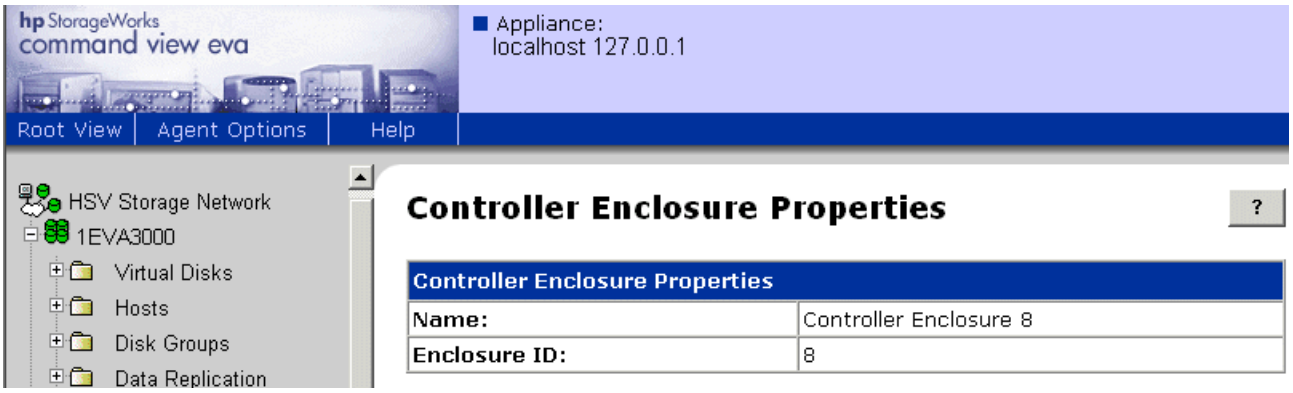



**Figure 35 Controller Enclosure Properties page**

For more information about enclosures, see Fibre Channel Drive Enclosures and HSV110 controllers.

# 4 Storage system hardware components

This chapter describes the Enterprise hardware components.

## Fibre Channel drive enclosures

The drive enclosure contains the disk drives used for data storage. A storage system includes multiple drive enclosures. The major components of the enclosure are:

- 2.125-Gb, dual loop, 14-drive enclosure.
- Dual-loop, FC-AL I/O modules and cable components that are the interface between the drives and the host controllers.
- Fiber optic cables.
- Copper Fibre Channel cables.
- Fibre Channel disk drives and drive blanks.
- Power and cooling components including power supplies, cords, and blowers.
- EMU that monitors the operation of the enclosure and the elements while displaying status. When the EMU detects a condition, it generates a local alarm and reports the condition to the controller.

### Enclosure layout

The disk drives mount in bays in the front of the enclosure (Figure 36). The bays are numbered sequentially from left to right. A drive is referred to by its bay number. Enclosure status indicators are located in the lower-right, front corner (see Figure 5). Figure 36 shows the front and rear views of the FC drive enclosure.

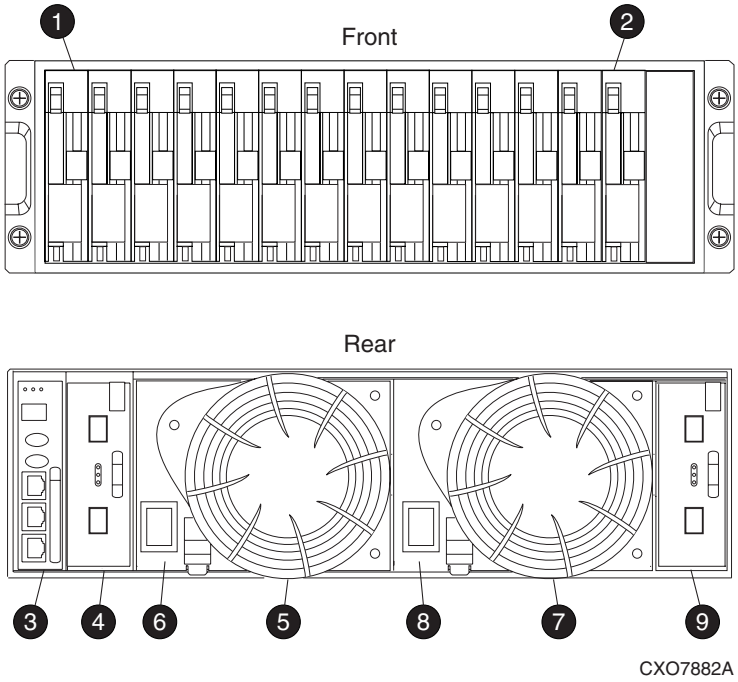
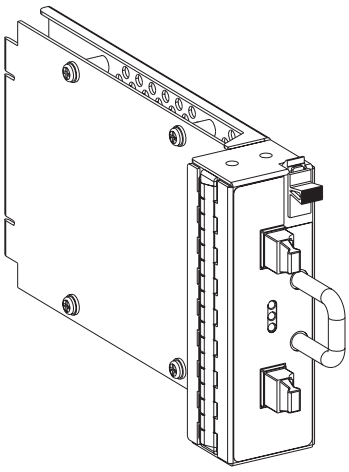



**Figure 36 FC drive enclosure—front and rear views**

1. Drive bay 1
2. Drive bay 14
3. EMU
4. I/O module B
5. Blower 1
6. Power supply 1
7. Blower 2
8. Power supply 2
9. I/O module A</ara>

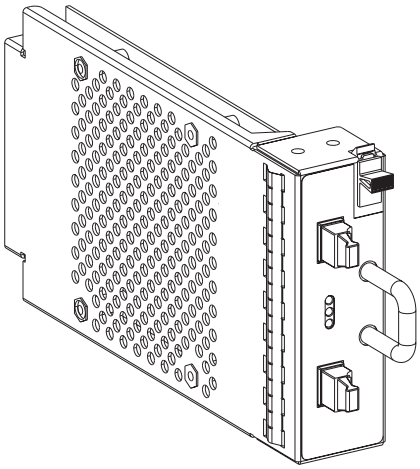
## FC-AL I/O modules

Two I/O modules (see Figure 39 and Figure 40) provide the interfaces between the drive enclosure and the controllers. They route data to and from the drives using Loop A and Loop B, the dual-loop configuration.



CXO7421A

**Figure 37 I/O module B**



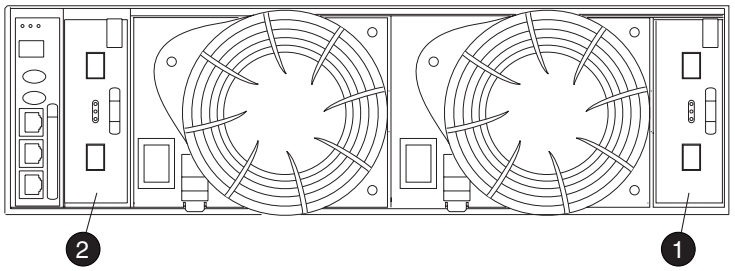
CXO7420A

**Figure 38 I/O module A**

Enterprise supports only dual-controller, dual-loop operation. Each controller is connected to both the I/O module A and I/O module B in each drive enclosure.

The A and B I/O modules are functionally identical, but they are not interchangeable (see Figure 39 for I/O module locations). The physical differences between the modules ensure that you can install:

- The A module (1) only at the right end of the enclosure, behind drive bay 1.
- The B module (2) only at the left end of the enclosure, next to the EMU.




CXO7951A

**Figure 39 I/O module locations**

**1.** I/O module A

2. I/O module B

The I/O modules are major components in the Fibre Channel loop. Each module has two ports that can both transmit and receive data for bidirectional operation. Activating a port requires connecting a transceiver to the port via fiber optic cables. The port function depends upon the loop (see Figure 40).

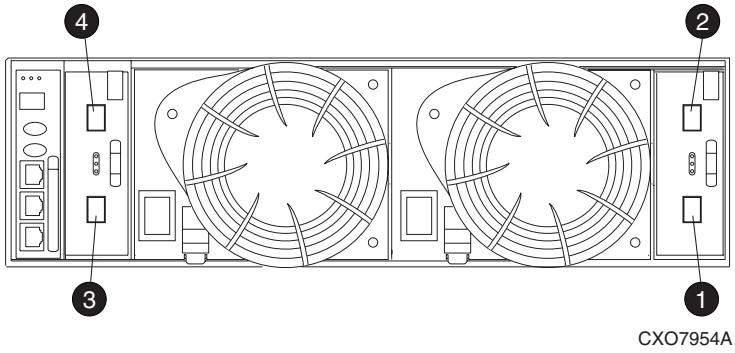



**Figure 40 Input and output ports**

1. Loop A bottom port
2. Loop A top port
3. Loop B bottom port
4. Loop B top port

## I/O module status displays

The three green LEDs on the A and B I/O modules display the status. The LED status displays for an operational I/O module are shown in Table 6. Table 7 shows the status displays for a non operational I/O module.

**Table 6 Operational I/O module status indicators**

| Top | Power | Bottom | Descriptions |
|---|---|---|---|
| Off | On | Off | • I/O Module is operational |
| On | Flashing, then On | On | • Top port—Fibre Channel drive enclosure signal detected.<br>• Power—Flashes for about 90 seconds after initial power application, then remains constant.<br>• Bottom port—Fibre Channel drive enclosure signal detected. |
| On | On | On | • Top port—Fibre Channel drive enclosure signal detected.<br>• Power—Present.<br>• Bottom port—Fibre Channel drive enclosure signal detected. |
| Flashing | Flashing | Flashing | • When the locate function is active, all three indicators flash simultaneously. The Locate function overrides all other indicator functions. Therefore, an error could be detected while the Locate function is active and not be indicated until the Locate action terminates. |

**Table 7 Non-operational I/O module status indicators**

| Top | Power | Bottom | Descriptions |
|---|---|---|---|
| On | On | Off | • Top port—Fibre Channel drive enclosure signal detected.<br>• Power—Present.<br>• Bottom port—No Fibre Channel drive enclosure signal detected. Check transceiver and fiber cable connections.<br>NOTE:<br>This status applies to configurations with and without FC loop switches. |
| Off | On | On | • Top port—No Fibre Channel drive enclosure signal detected. Check transceiver and fiber cable connections.<br>• Power—Present.<br>• Bottom port—Fibre Channel drive enclosure signal detected . |
| Flashing | On | On | • Top port—EMU detected possible transceiver problem. Check transceiver and fiber cable connections.<br>• Power—Present.<br>• Bottom port—Fibre Channel drive enclosure signal detected . |
| On | On | Flashing | • Top port—Fibre Channel drive enclosure signal detected.<br>• Power—Present.<br>• Bottom port—EMU detected possible transceiver problem. Check transceiver and fiber cable connections.<br>NOTE:<br>The EMU will not flash the lower indicator on its own. It will flash only in response to a locate command. You can flash each of the lights independently during a locate action. |
| Off | Off | Off | • No I/O module power.<br>• I/O module is nonoperational.<br>• Check power supplies. If power supplies are operational, replace I/O module. |

## I/O module power

The I/O module +5 VDC power sensing device protects the modules against overcurrent conditions. If the +5 VDC current exceeds 2.5 A rms (nominal), the sensor opens, removing the +5 VDC input from the I/O module, thereby disabling the module until:

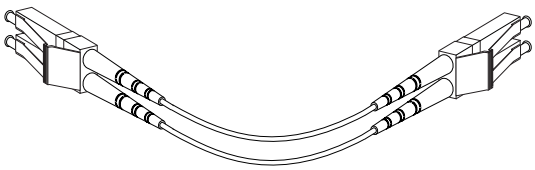
- The I/O module is replaced, if defective.
- The overcurrent condition no longer exists.

NOTE:

A disabled I/O module cannot transfer data and disconnects all the drives in the enclosure from the loop.

# Fiber optic cables

The Enterprise Virtual Array Fibre Channel 9000-Series implementation uses orange, 50-µm, multi-mode, fiber optic cables. Figure 41 shows the fiber optic cable assembly, which consists of two, 2-m fiber optic strands and small form-factor connectors on each end.



CXO7972A

**Figure 41 2-Gb fiber optic components**

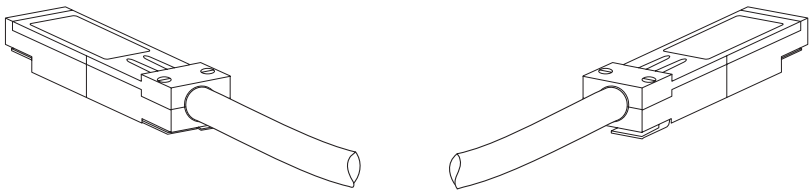
To ensure optimum operation, the fiber optic components (that is, the transceivers, the fiber optic cable connectors, and the fiber within the cable) require protection from contamination and mechanical hazards. Failure to provide this protection can reduce the amount of light passing through a component, thereby degrading operation. Actions that can avoid degradation include

- To avoid breaking the fiber within the cable, do not:
  - Kink the cable.
  - Use a cable bend-radius of less than 30 mm (1.18 in).
- To avoid deforming, or possibly breaking the fiber within the cable, do not place heavy objects on the cable.
- To avoid contaminating the optical connectors:
  - Do not touch the connectors.
  - Never leave the connectors exposed to the air.
  - Install a dust cover on each transceiver and fiber cable connector when they are disconnected.

If an open connector is exposed to dust, or there is any doubt about the cleanliness of the connector, clean the connector as described in Protecting Fiber Optic Connections.

## Copper Fibre Channel cables

The Enterprise Virtual Array Fibre Channel 10000-Series implementation uses copper Fibre Channel cables to connect the drive enclosures to each other, or to the loop switches and to the HSV controllers. The cables are available in 0.6-meter and 2.0-meter lengths. Copper cables provide performance comparable to fiber optic cables. Copper cable connectors differ from fiber optic small form-factor connectors (see Figure 42).



CXO8164A

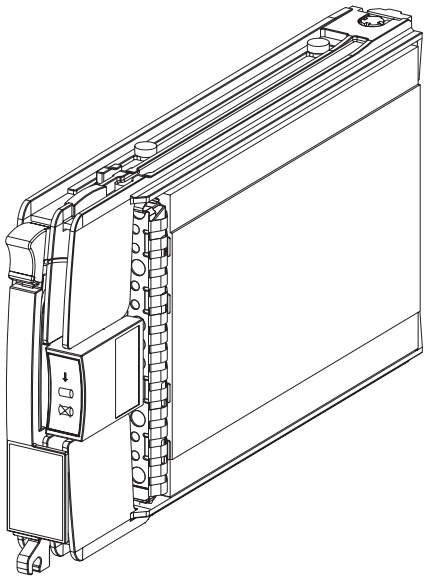
**Figure 42 Copper Fibre Channel cable**

## Fibre Channel disk drives

The Fibre Channel drives are hot-pluggable and include the following features:

- Dual-ported 2 Gbps FC-AL interface that allows up to 120 drives to be supported per FC-AL pair.
- 36 GB, 72 GB, 146 GB, and 300GB10K and 15K rpm, and additional drives as certified.
- Compact, direct-connect design for maximum storage density and increased reliability and signal integrity.
- Both online (normal, high-performance) and near-online (lower-performance) drives.
- Improved drive cooling essential for high performance.
- Better vibration damping for improved performance.
- Greater component commonality throughout the Enterrise Virtual Array.

Up to 14 disk drives can be contained in a Fibre Channel drive enclosure. Figure 43 shows the front view of a Fibre Channel disk drive.



CXO6695B

**Figure 43 Fibre Channel disk drive**

HP-supplied disk drives conform to the enclosure initiated Enclosure Services Interface (ESI).

△ CAUTION:

Maintaining proper air flow within the enclosure requires installing a drive or a drive blank in each drive bay. To avoid overheating, never remove more than one drive or drive blank from an operating enclosure at the same time. To prevent overheating and ensure proper operation, HP recommends installing a drive of equal or greater capacity, or a drive blank, as soon as possible.

## Drive status reporting

Three status indicators (see Figure 44) display the drive operational status.

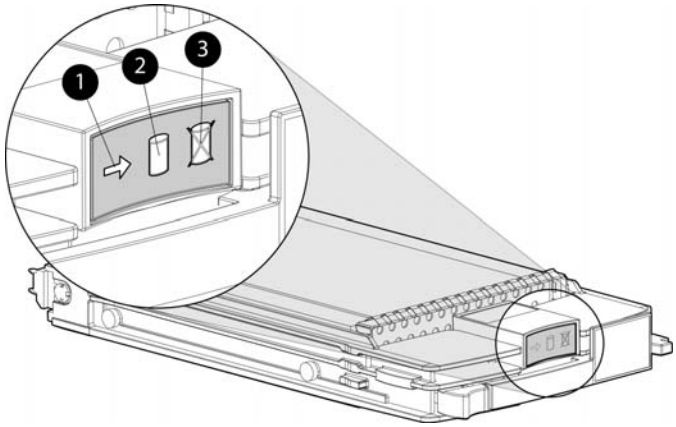



**Figure 44 Disk drive status indicators**

1. Activity indicator
2. Online indicator
3. Fault indicator

Table 8 describes the status indicators.

**Table 8 Disk drive status indicator descriptions**

| Status indicator | Description |
|---|---|
| Activity  | This green status indicator is a “drive ready” indicator and is on when the drive is idle. |
| Online  | The green status indicator for this icon is controlled by the disk drive. The status indicator will be off when:<br>• There is no controller on the bus.<br>• +5.1 VDC is not available.<br>• The drive is not properly installed in the enclosure. |
| Fault  | The amber status indicator flashes in synchronization with the other two status indicators in response to the EMU locate command. Depending on the host controller, the indicator for this icon can flash when the controller detects an error condition. |

## Drive status displays

The two green and one amber LEDs are either on, off, or flashing. In some configurations, the host controller can control the status LEDs. The operational drive LED status displays are shown in Table 9. See Table 10 for the non-operational drive status LED displays.

**Table 9 Operational drive status displays**

| Activity  | On-line  | Fault  | Description |
|---|---|---|---|
| Flashing (medium speed) | On | Off | Initial startup. |
| On | On | Off | The operational drive is not being accessed. |
| Flashing (high speed) | Flashing (medium speed) | On | The drive is being located. |
| Flashing | On | Off | The drive is operational and active. |

**NOTE:**

The drive is configured as part of an array. DO NOT replace an active drive.

**Table 10 Non-operational drive status indications**

| Activity  | On-line  | Fault  | Description |
|---|---|---|---|
| On | On | On | Indicates no connection or the controllers are offline. Recommended corrective actions:<br>1. Check power supplies for proper operation.<br>2. If defective, replace drive. |
| On | Off | Flashing | Indicates drive error/not active. Recommended corrective actions:<br>1. Verify drive loop continuity.<br>2. Replace drive. |

## Drive power

The drive voltage backplane sensors (+5.1 VDC and +12.1 VDC) can detect a drive overcurrent condition. When a drive overcurrent condtion exists, the sensor disconnects the voltage from the drive to prevent writing data to the drive. The drive is disabled until one of the following conditions occurs:

- The drive is replaced, if defective.
- The overcurrent condition no longer exists.

## Drive blank

To maintain the proper enclosure air flow, a drive or a drive blank must be installed in each drive bay. The drive blanks (see Figure 45) maintain proper airflow within the disk enclosure.

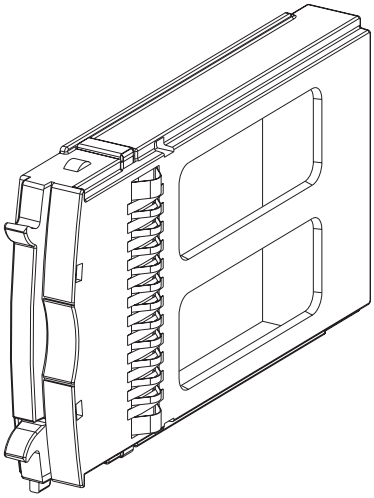



**Figure 45 Drive blank**

## Replacing a disk or drive blank

To replace a disk, complete the procedures outlined in Appendix D: Customer Replaceable Units.

The disk replacement kit contains detailed replacement instructions.

△ CAUTION:

Removing more than one drive at a time can cause the enclosure to overheat. To prevent overheating and ensure proper operation, install a drive of equal or greater capacity, or a drive blank, as soon as possible.

# Power and cooling components

This section describes the function and operation of the disk enclosure power supplies and blowers. Figure 46 identifies the major power supply and cooling components.

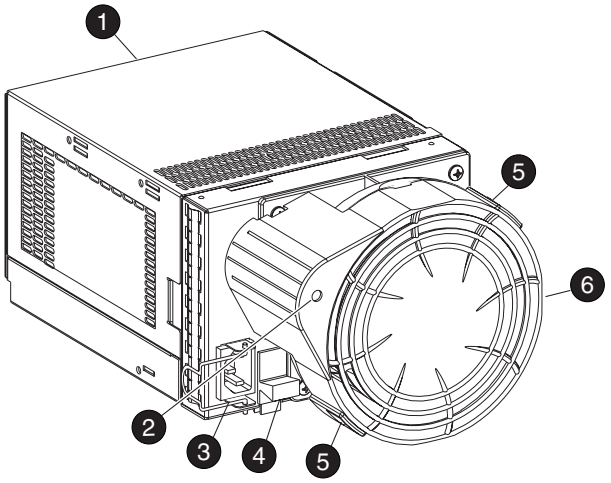



**Figure 46 Power supply and blower assembly components**

1. Power supply assembly
2. Power supply and blower status LED
3. AC Input connector with bail
4. Module latch (port-wine colored)
5. Blower tabs (port-wine colored)
6. Blower element

## Enclosure power

The two power supplies mount in the rear of the enclosure. The supplies are autoranging and operate on a country-specific AC input voltage of 202 to 240 VAC ±10%, 50 to 60 Hz, ±5%, (188 to 264 VAC, 47 to 63 Hz).

The DC outputs of this power supply are:

- +5.1 VDC for the EMU, I/O module, backplane, and drives
- +12.1 VDC for the drives
- +12.5 VDC for the drives

The nominal output of each power supply is 499 W, with a peak output of 681 W. A single power supply can support an enclosure with a full complement of disks, blowers, EMU, and I/O module.

The power supply circuitry provides protection against:

- Overloads
- Short circuits
- Overheating

Power supply status and diagnostic information is reported to the EMU with voltage, current, and temperature signals.

See Appendix A: Regulatory notices and specifications for the enclosure power specifications.

## Temperature sensing

The power supply temperature sensor provides a temperature range signal to the EMU. The EMU can use this signal to set the blower speed.

The power supply internal temperature can also set the speed of the blower. The higher the power supply temperature, the faster the speed of the blower. Should the power supply temperature exceed a preset value, the power supply automatically shuts down.

## Blowers

The blower mounts on the rear of the power supply. A power supply connector is the interface between the blower and the enclosure for:

- Blower speed control to the blower
- Blower speed to the EMU through the power supply
- Power supply high speed enable
- Blower operating voltage

The power-supplymounted blowers cool the enclosure by circulating air through the enclosure. The rate at which air moves (the air flow) determines the amount of cooling and is a function of blower speed (rpm). These blowers, under the control of the EMU or the associated power supply, can operate at multiple speeds. This ensures that when the enclosure temperature changes the blowers can automatically adjust the air flow.

If a blower is operating too slowly or has stopped (a "blower failure"), internal circuitry automatically operates the remaining blower at a higher speed. Simultaneously, the error condition is reported to you in several ways, including the power supply LED, the audible alarm, the enclosure fault LEDs, and the EMU alphanumeric display.

Should both blowers fail, the power supplies automatically shut down.

**NOTE:**

The blower units are field-replaceable units. The units can be replaced, individually, while the system is running. The units are also interchangeable. The failure of a power supply +12.5 VDC circuit disables the associated blower.

### Power supply and blower status reporting

The green status LED on the blower displays the status of both the power supply and the blower. See Table 11 for definitions of the LED displays.

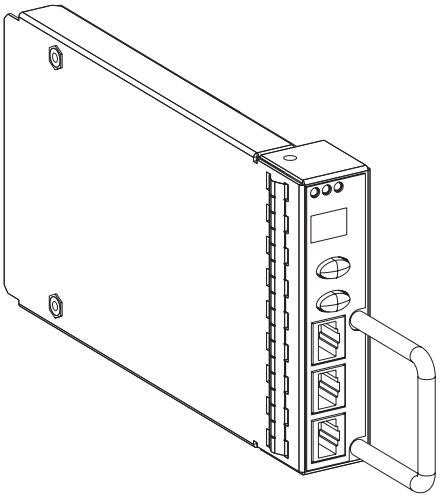
**Table 11 Power supply/blower status indicators**

| Blower status LED | Description |
|---|---|
| On | Both the power supply and the blower are operational. |
| Flashing | The power supply or the blower locate function is active. |
| Off | The power supply or the blower is non–operational. When there is a blower problem, the other blower runs at a higher speed. Recommended corrective actions:<br>• Check blower for proper operation. Replace if defective.<br>• Check power supplies for proper operation. Replace if defective. |

# Drive enclosure EMU

The EMU provides increased protection against catastrophic failures. The EMU detects conditions such as failed power supplies, failed blowers, elevated temperatures, and external air sense faults and communicates these conditions to the storage system controllers.

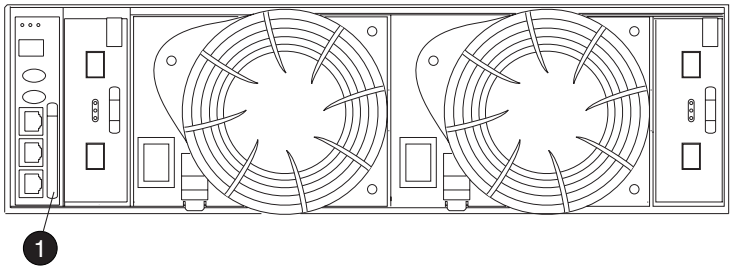
Figure 47 shows the drive enclosure EMU as a standalone unit.



CXO6697A

**Figure 47 Drive enclosure EMU**

The EMU for Fibre Channel-Arbitrated Loop (FC–AL) drive enclosures is fully compliant with SCSI-3 Enclosure Services (SES), and mounts in the left rear bay of a drive enclosure (see 1, Figure 48).




CXO7971A

**Figure 48 EMU location**

**1.** EMU

## Controls and displays

Figure 49 identifies the location and function of the EMU displays, controls, and connectors.

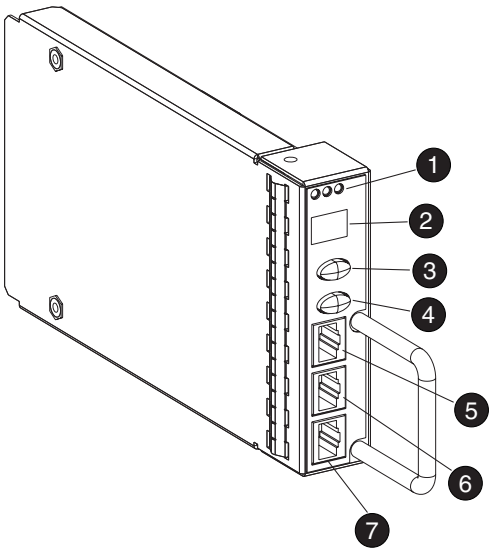



**Figure 49 EMU controls and displays**

1. Status LEDs
   These 3 LEDs display the EMU and enclosure status.
2. Alphanumeric display
   A 2–character, 7–segment alphanumeric display of the enclosure functions and status.
3. Function Select (top) push button
   The primary function of this push button is to select a display group function. The LED is on when an error condition exists.
4. Display Group Select (bottom) push button
   This push button is used to view display groups and control the audible alarm. The LED is on when the audible alarm is muted or disabled.
5. RS232 ONLY–A keyed, RJ45-type connector for use by HP Authorized Service Representatives.
6. LCD ONLY–An unused RJ45-type connector.
7. CAB ONLY–A keyed, RJ45-type enclosed address bus connector.

⚠ **WARNING!**

To reduce the risk of electrical shock, fire, or damage to the equipment, do not plug telephone or telecommunications connectors into the "RS232 ONLY" receptacle.

## EMU functions

The primary functions of the EMU include:

- Using the Enclosure Services Processor (ESP) to control the Enclosure Services Interface (ESI) and communicate with the controllers.
- Assigning the Enclosure Number (En), based upon the cabinet address bus feature.
- Displaying the bay 1 loop ID.
- Monitoring enclosure operation.
- Detecting, reporting, recording, and displaying conditions.
- Displaying EMU, enclosure, and element status.
- Implementing automatic corrective actions for some conditions.
- Providing enclosure status data to the controllers.
- Reporting the WWN and the logical address of all drives.

**NOTE:**

Although the EMU can determine the logical address of a drive, the EMU can neither display nor change this information. The Command View EVA GUI can display the addresses from the EMU-supplied status information.

## EMU monitoring functions

The internal EMU circuitry monitors the enclosure and element functions listed in Table 12.

**Table 12 EMU monitoring functions**

| Element | Monitored Functions | |
|---|---|---|
| Blowers | • Installation<br>• Removal | • Type<br>• Speed (rpm) |
| Disk drives | • Installation<br>• Removal<br>• Bypass status | • Loop ID<br>• Temperature<br>• Drive fault |
| EMU | • Temperature<br>• Operation | • Type<br>• Revision level |
| Enclosure | • Enclosure power<br>• Enclosure fault | • Backplane type<br>• Backplane revision level |
| I/O module | • Installation<br>• Removal<br>• Status | • Type<br>• Revision level |
| Power supplies | • Installation<br>• Removal<br>• Status<br>• Type<br>• Revision level | • +5 VDC voltage and current<br>• +12 VDC voltage and current<br>• Total power<br>• Temperature |
| Transceiver | • Type | • Link status |

## EMU displays

The EMU uses a combination of LEDs, icons, the two-character alphanumeric display, and an audible alarm to indicate the operational status of the enclosure and the enclosure elements (see Table 13).

**Table 13 EMU status indicators**

| Indicator | Function |
|---|---|
| Audible Alarm[1] | Any EMU detected condition causes this indicator to sound. |
| EMU Icons[2]  | The EMU LEDs above the icons display the enclosure and EMU status. |
| Alphanumeric Display[3] | The 2-character, 7-segment display can display alpha-numeric characters. |

[1]For information about the audible alarm, see Enclosure and Element Conditions.
[2]For a description of the LED functions, see EMU LED Displays.
[3]For a description of the alphanumeric display functions, see Using the Alphanumeric Display.

## EMU LED displays

The EMU status LEDs are located above the alphanumeric display (see Figure 50). These icons match those on the front, lower right corner of the enclosure.

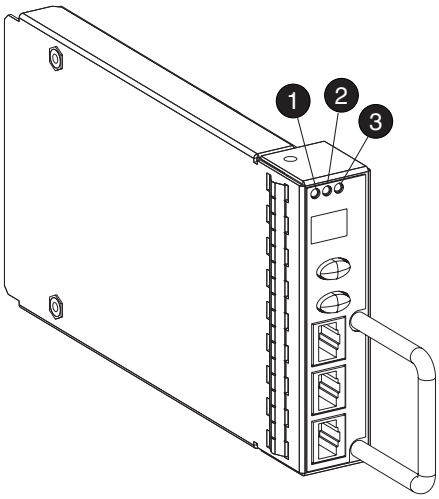



**Figure 50 EMU status LEDs**

1. EMU Status LED
   This flashing green LED is the heartbeat for an operational EMU.
2. Enclosure Power Status LED
   This green LED is on when both the +5 V DC and +12 V DC are correct.
3. Enclosure Fault LED
   This amber LED is normally Off. The LED is ON when an enclosure error condition exists.

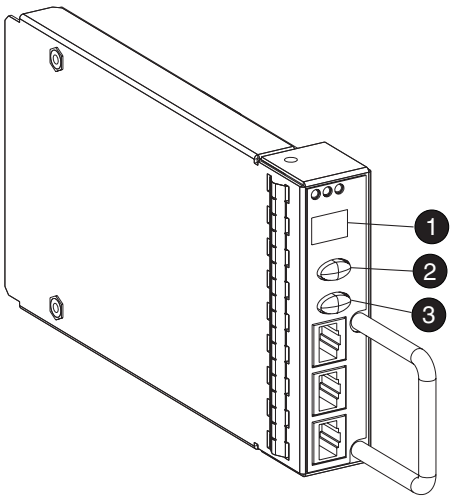
You can determine the EMU and enclosure status by analyzing the EMU LED displays in Table 14.

**Table 14 EMU LED displays**

| EMU LED green | Power LED green | Fault LED amber | Status and recommended actions |
|---|---|---|---|
| Flashing | Flashing | Flashing | The EMU locate function is active. This display has precedence over all others. Fault conditions cannot be displayed when the locate function is active. |
| Flashing | On | Off | The EMU is operational. The enclosure power (both +5 V DC and +12 V DC) is present and correct. There are NO enclosure faults. |
| Flashing | On | On | The EMU is operational. There is an enclosure fault. Check the alphanumeric display error code for detailed information about the problem. |
| Flashing | Off | Off | The EMU is operational. This display may be present when power is initially applied to the enclosure. **Note**: When the +5 VDC is incorrect, all the LEDs are Off. |
| On | On | Off | There is an EMU fault There is no enclosure fault. |
| Off | On | Off | There is an EMU fault There is no enclosure fault. |
| Off | Off | Off | There is an enclosure fault. Either +5 VDC is incorrect, or both +5 VDC and +12 VDC are incorrect. Other error conditions may exist. |

## Using the alphanumeric display

The two-character alphanumeric display is located at the top of the EMU (see 1, Figure 51). This 7-segment display provides information about multiple enclosure functions. The push buttons control the data displayed or entered.




CXO7373A

**Figure 51 Alphanumeric display and controls**

1. Alphanumeric display
2. Function select (top pushbutton)
3. Display Group select (bottom pushbutton)

**NOTE:**

7-segment display limitations preclude displaying uppercase characters B, K, M, N, Q, R, S, T, V, W, X, Y, or Z, or the lowercase characters a, e, f, g, j, k, l, m, p, q, s, t, v, w, x, y, or z. The lowercase characters b, c, d, h, i, o, r, and u displays are similar to the actual characters.

### Alphanumeric display description

The top-level, two-character alphanumeric display (En, Li, rG, Au, and Er), is the display group. The function of the other displays is display-group dependent. The default display is the enclosure number, a decimal number in the range 00 through 14. The push buttons allow you to select the alphanumeric display or to enter data.

- The bottom push button (see 3, Figure 51) enables you to sequentially move between groups and to select a display group.

  See EMU display groups for a description of these display groups.
- The top push button, (see 2, Figure 51) enables you to move between the levels within a display group.

### Display groups

When you ress and release the bottom push button, the alphanumeric display selects a different display group. EMU display groups describes the display groups.

**Table 15 EMU display groups**

| Display | Display Group | Description |
|---|---|---|
| En | Enclosure Number | The enclosure number is the default display and is a decimal number in the range *00* through *14*. See Using the Enclosure Number Feature for detailed information. |
| Li | Bay 1 Loop ID | This display group has a single sublevel display that defines the enclosure bay 1 loop ID. Valid loop IDs are in the range *00* through *7F*. |
| rG | Reporting Group | This display group has two, 2-digit displays that define the reporting group number in the range *0000* through *4095*. |
| Au | Audible Alarm | This display group provides control over the audible alarm or horn. The sublevel displays are audible alarm enabled (on) or audible alarm disabled (oF). See Enclosure and Element Conditions for detailed information. |
| Fr | Firmware Revision | This display group defines the EMU code firmware version. |
| Er | Error Condition | This display group reads Er when there is an error condition. See Enclosure and Element Conditions for detailed information. |

**NOTE:**

Any time you press and release the bottom push button (see 3, Figure 51), the display will change to En, Li, rG, Au, or Er.

A flashing alphanumeric display indicates that you can edit an address, state, or view a condition report.

## EMU push button LEDs

The push button LEDs display error conditions and the state of the audible alarm.

- When an error condition exists, the top push button LED is On.
  - For a single error condition, the LED is On until the error condition is viewed.
  - For multiple errors, the LED is On until the last error condition is vieed.
- The bottom push button LED is On only when the alarm is muted or disabled.

## Audible alarm operations

Whenever an error condition exists, the audible alarm automatically sounds until all errors are corrected. You have the option of either muting or disabling the alarm. Using these options results in the following conditions:

- A disabled audible alarm *cannot sound*.
- Even when muted, *any new error condition* causes the alarm to sound.

### Audible alarm patterns

The duration and number of times the audible alarm sounds, the sound pattern, is a function of the error condition type. See Table 16 for the duration and the approximate relationship of these alarms. The most severe, active error condition controls the alarm pattern.

**Table 16 Audible alarm sound patterns**

| Condition Type | Cycle 1 | Cycle 2 |
|---|---|---|
| UNRECOVERABLE |  | |
| CRITICAL |  |  |
| NONCRITICAL |  |  |
| INFORMATION |  |  |
| Legend |  Alarm On | Alarm Off |

### Controlling the audible alarm

You can control the alarm with the push buttons. This process includes muting, enabling, and disabling. When an error condition exists, the alphanumeric display reads *Er*, the alarm sounds, and you can:

- Correct all errors, thereby silencing the alarm until a new error occurs.
- "Mute," or *temporarily* disable, the alarm by pressing and holding the bottom push button. The alarm remains Off until another error occurs, or until you enable ("unmute") the alarm. When a new error occurs, the alarm sounds and the push button LED is Off.

  Using the mute feature ensures that you are aware of the more severe errors and provides you with the capability of correcting them promptly.
- Disable the alarm to prevent any error condition from sounding the alarm.

**NOTE:**

Disabling the alarm does not prevent the EMU alphanumeric display from displaying Er. Nor does it prevent Command View EVA from displaying the error condition report.

When the alarm is enabled (*on*), the bottom push button LED is Off.

## Enabling the audible alarm

To enable the alarm:

1. Press and release the bottom push button until the alphanumeric display is *Au*.
2. Press and hold the top push button until the alphanumeric display is a Flashing *oF* (Audible Alarm Off).

**NOTE:**

When the alarm display is *flashing*, pressing and holding the top push button causes the display to rapidly change between *on* and *oF*. Pressing and releasing the top push button causes the display to select the next state.

3. Press and release the top push button to change the display to a Flashing *on* (Audible Alarm On).
4. Press and release the bottom push button to accept the change and to display *Au*. The bottom push button LED is now Off.

## Muting or unmuting the audible alarm

When there is an error condition, determine one of the following:

- The error does not require immediate corrective action.
- You cannot implement a correction (such as, you require a replacement element).

To mute the audible alarm:

**NOTE:**

*Er* is displayed in the alphanumeric display when an error condition is present.

1. Press and hold the bottom push button until the LED is On.

   A muted alarm will remain Off until a new condition report exists.
2. To unmute the alarm, press and hold the bottom push button until the LED is Off. When a new error condition occurs, the alarm will sound.

## Disabling the audible alarm

**CAUTION:**

Disabling the audible alarm increases the potential of damage to equipment from a reported but unobserved fault. HP does not recommend disabling the audible alarm.

Disabling the audible alarm affects only one enclosure. This action does not affect condition report displays on the EMU alphanumeric display or the Command View EVA GUI.

To disable the alarm:

1. Press and release the bottom push button until the alphanumeric display is *Au*.
2. Press and hold the top push button until the alphanumeric display is a Flashing *on* (Audible Alarm On).

**NOTE:**

When the alarm display is flashing, pressing and holding the top push button causes the display to rapidly change between *on* and *oF*.

Pressing and releasing the top push button causes the display to select the next state.

3. Press and release the top push button to change the display to a Flashing *oF* (Audible Alarm Off).
4. Press and release the bottom push button to accept the change and display *Au*. The bottom push button LED is now On.

**NOTE:**

A disabled audible alarm (the bottom push button LED is On) cannot sound for any error condition. All errors will be displayed on the Command View EVA GUI and the EMU alphanumeric display. HP recommends that rather than disabling the audible alarm, you use the mute function (see How to Mute or Unmute the Audible Alarm). When you use the disable function, you should enable the audible alarm as soon as possible (see How to Enable the Audible Alarm).

## Using the enclosure number feature

This section provides a general description of the purpose, function, and operation of the EMU enclosure number (En) feature.

### En description

In a single rack configuration, the En is a decimal number in the range 00 through 14, which is automatically assigned by the enclosure address bus.

**NOTE:**

Your storage system may use an enclosure address bus higher than *14* if your Enterprise supports an optional expansion cabinet.

By default, the two-character alphanumeric display shows this number. Pressing the bottom push button changes the display to *En*, the En display mode.

When the display is *En*, pressing and releasing the top push button displays the enclosure number.

A display of *00* indicates that the enclosure is not connected to the enclosure address bus. When this condition exists, there is no EMU-to-EMU communication over the enclosure address bus. This configuration is known as "just-a-bunch-of-disks," or a JBOD configuration.

A display of 01 through 14 indicates that the enclosure is physically connected to the enclosure address bus and can exchange information with other enclosures on the enclosure address bus. Th decimal number indicates the physical position of the enclosure in relation to the bottom of the rack.

- *01* is the address of the enclosure connected to the bottom connector in the first (bottom) junction box (JB).
- *14* is the address of the enclosure closest to end of the bus, the top connector in the last (upper) JB.

**NOTE:**

The enclosure address bus connection determines the En. For a single rack, the display is a decimal number in the range *01* through *14*. For a multiple (two) rack configuration, the display is decimal number in the range *01* through *24*. For JBOD configurations the enclosure En display is always *00*. You can only display, never change the *En* value.

Unless there is an error condition, the display automatically returns to the enclosure number (*01* through *14*) one minute after a push button was last pressed.

### Enclosure address bus

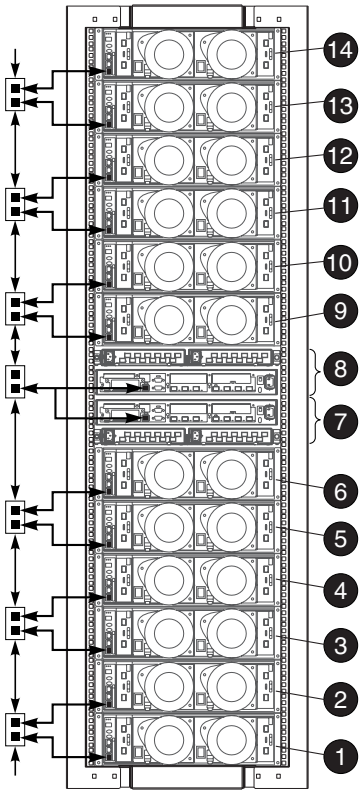
The enclosure address bus is composed of cables and either JBs mounted on the rack with screws or shelf ID expansion cables attached to the rack with velcro straps that interconnect the drive enclosures and controller enclosures to provide a means for managing and reporting environmental conditions within the rack. Two drive enclosures connect with keyed 10-pin connectors to each JB or shelf ID expansion cable. The EMUs collect the data for the associated enclosure.

The drive enclosure numbers are always assigned by the enclosure address bus. Connecting the EMU CAB ONLY connector to either an enclosure address bus JB or shelf ID expansion cable automatically establishes an enclosure number of *01-14*. Any drive enclosure not connected to the enclosure address bus has the same enclosure number, *00*.

**NOTE:**

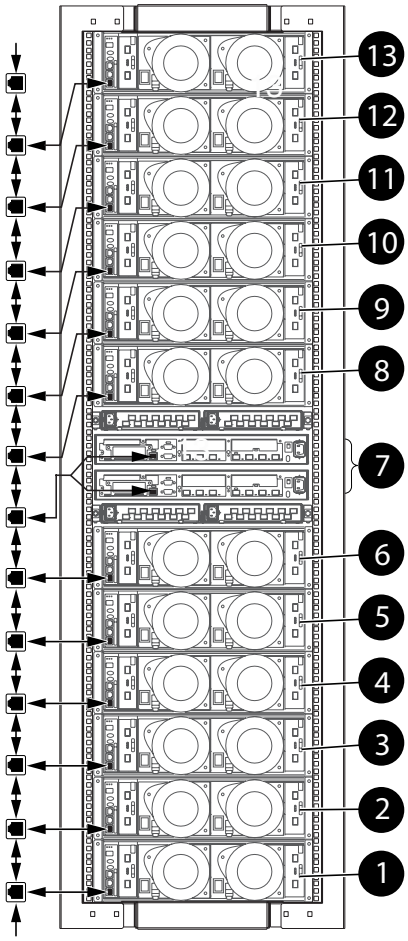
The enclosure number is automatically assigned. You cannot manually assign an enclosure number.

Based on the cable bus installation shown in Figure 54, the enclosures are numbered as shown in Figure 52.




CXO7956A

**Figure 52 Enclosure numbering with JBs**




0046a-2

**Figure 53 Enclosure numbering with shelf ID expansion cables**

**NOTE:**

If an expansion rack is used with your Enterprise configuration, the enclosure numbering shown above may change or contain additional numbering. Refer to the *HP StorageWorks Enterprise Virtual Array Hardware Configuration Guide* for more information.

For more information about the reporting group number, see Viewing the Reporting Group Feature.

### Enclosure address bus connections

Connecting the enclosures to the rack JBs or shelf ID expansion cables establishes the enclosure address bus. The enclosures are automatically numbered, based on either the JB or shelf ID expansion cable to which they are connected. Figure 54 and Figure 55 show the typical configuration of a 41U cabinet with 14 enclosures (3U high).

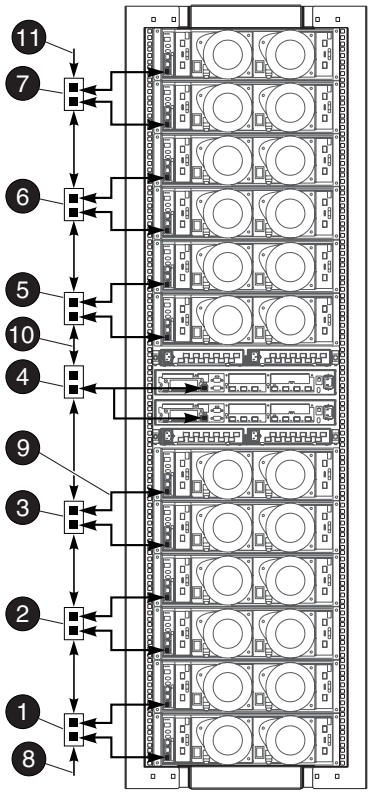



**Figure 54 Enclosure address bus components with JBs**

**Callouts:**

Junction Boxes (JB)

1. JB 1–Enclosures 1 and 2
2. JB 2–Enclosures 3 and 4
3. JB 3–Enclosures 5 and 6
4. JB 4–Enclosure 7
5. JB 5–Enclosures 9 and 10
6. JB 6–Enclosures 11 and 12
7. JB 7–Enclosures 13 and 14

   Components
8. Bottom terminator
9. JB-to-Enclosure cable
10. JB-to-JB cable
11. Top terminator

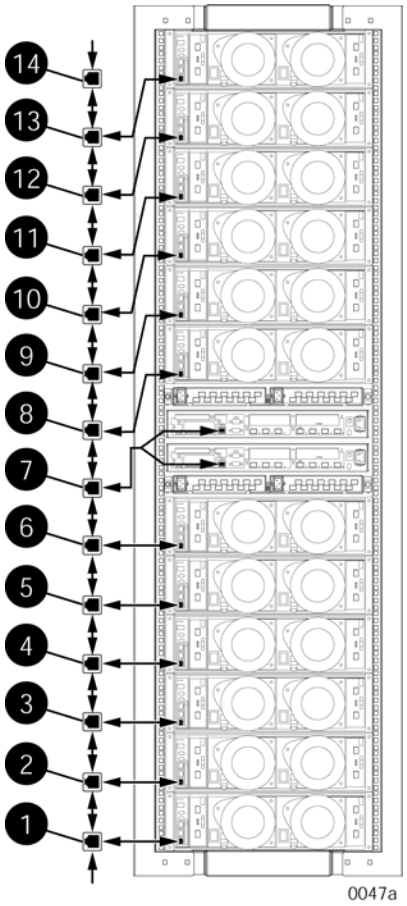



**Figure 55 Enclosure address bus components with shelf ID expansion cables**

**Callouts:**

1. Shelf ID expansion cable port 1—Enclosure 1
2. Shelf ID expansion cable port 2—Enclosure 2
3. Shelf ID expansion cable port 3—Enclosure 3
4. Shelf ID expansion cable port 4—Enclosure 4
5. Shelf ID expansion cable port 5—Enclosure 5
6. Shelf ID expansion cable port 6—Enclosure 6
7. Shelf ID expansion cable port 7—Enclosure 7 (used for both controllers)
8. Shelf ID expansion cable port 8—Enclosure 8
9. Shelf ID expansion cable port 9—Enclosure 9
10. Shelf ID expansion cable port 10—Enclosure 10
11. Shelf ID expansion cable port 11—Enclosure 11
12. Shelf ID expansion cable port 12—Enclosure 12
13. Shelf ID expansion cable port 13—Enclosure 13
14. Shelf ID expansion cable port 14—Enclosure 14 (not used on the same loop as port 8)

### Enclosure and element conditions

The EMU constantly monitors enclosure operations and reports conditions that could affect operations. These errors are grouped, according to their severity, into the following types:

- Unrecoverable condition
- Critical condition
- Noncritical condition
- Information condition

See Appendix B: EMU Generated Condition Reports for definitions of individual condition reports.

When the audible alarm is not muted or disabled, each condition generates a unique audible alarm as described in Audible Alarm Patterns.

## Using the condition reporting feature

The EMU reports errors to you by changing the alphanumeric display to *Er* and sounding the audible alarm. A condition report has precedence over all other displays.

**NOTE:**

An error always generates a condition report. Not all condition reports are generated by errors.

### Condition report terminology

Each EMU detected condition generates a condition report containing the following information:

- Element type (et)
- Element number (en)
- Error code (ec)

Each condition report:

- Appears on the EMU alphanumeric display.
- Sounds the audible alarm.
- Is stored in the error queue.
- Is provided to the HSV110 controller for processing and display by Command View EVA.

The condition types, condition reports, and the interaction between conditions are defined in the following sections.

#### UNRECOVERABLE condition

This is the most severe condition. The condition occurs when one or more enclosure elements fail and disable some enclosure functions. The enclosure may be incapable of correcting or bypassing the failure and require repairs to correct the error.

**NOTE:**

To maintain data integrity, HP recommends implementing corrective action *immediately* for an UNRECOVERABLE condition.

This type of condition requires immediate corrective action by you.

An UNRECOVERABLE condition establishes the following conditions:

- This condition has precedence over CRITICAL and NONCRITICAL errors.
- This condition has precedence over the INFORMATION condition.
- The audible alarm is On continuously, as shown in Table 16.

CRITICAL condition

A CRITICAL condition is less severe than an UNRECOVERABLE condition. This condition occurs when one or more elements inside the enclosure have failed or are operating outside of their specifications. The failure of the element makes continued normal operation of at least some elements in the enclosure impossible. Other elements within the enclosure may be able to continue normal operations.

Prompt corrective action to prevent system degradation is recommended.

A CRITICAL condition has precedence over NONCRITICAL and INFORMATION conditions, but does not have precedence over UNRECOVERABLE conditions.

When this codition is the most severe active condition, the audible alarm sounds three times per alarm cycle, as shown in Table 16.

NONCRITICAL condition

A NONCRITICAL condition is less severe than an UNRECOVERABLE condition or a CRITICAL condition. This condition occurs when one or more elements inside the enclosure have failed or are operating outside of their specifications. The failure of these elements do not affect continued normal operation of the enclosure. All devices in the enclosure continue to operate according to their specifications. The ability of the devices to operate correctly may be reduced should other errors occur.

Early correction to prevent system degradation is recommended.

A NONCRITICAL condition establishes the following conditions:

- An UNRECOVERABLE condition has precedence over this condition.
- A CRITICAL condition has precedence over this condition.
- This condition has precedence over INFORMATION condition.
- When this condition is the most severe error active, the audible alarm sounds two times per alarm cycle, as shown in Table 16.

INFORMATION condition

An INFORMATION condition is the least severe of the condition reports and does not require immediate correction. It advises you that a condition exists that does not reduce the capability of an element but that could become more severe and require corrective action later.

When only an INFORMATION condition is active, the audible alarm sounds once per alarm cycle, as shown in Table 16.

### Error queue

The EMU stores each condition report in the error queue until the problem is corrected, or for at least 15 seconds after the error is reported. This ensures that when there are multiple errors or a recurring error, each can be displayed. The complete report is stored and you recall any report using a combination of the top and bottom push buttons. Correcting the error removes the condition report from the error queue.

Each report in the queue contains the element type, the element number, and the error code. To remove information from this queue requires either clearing the error or replacing the EMU.

The EMU displays the error queue information based on severity level and time of occurrence.

**NOTE:**

When you are viewing an error, the occurrence of a more severe error takes precedence and the display changes to the most severe error.

The most severe error in the queue always has precedence, regardless of how long less severe errors have been in the queue.

This hierarchical display ensures that the most severe errors haveprecedence over less severe errors. The earliest reported condition within an error type has precedence over errors reported later. For example, if you have errors at all levels, the EMU displays them as follows:

1. UNRECOVERABLE errors in the sequence they occurred.
2. CRITICAL errors in the sequence they occurred.
3. NONCRITICAL errors in the sequence they occurred.
4. INFORMATION conditions in the sequence they occurred.

### Condition report format

Each condition report identifies the element affected (type and number), and the primary problem (the error code). Appendix B: EMU Generated Condition Reports provides detailed information about each condition report, and includes recommended corrective actions.

- **Element Type**

  This two-digit *hexadecimal* display defines the element type reporting the problem. The format for this display is *e.t.* with a period after each character. Codes *0.1.* through *F.F.* are valid element types.
- **Element Number**

  The second display is a two-digit *decimal* number that defines the element reporting the problem. The format for this display is *en.* with a period after the second character.
- **Error Code**

  The third display is a two-digit *decimal* number that defines the specific error code. The format for this display is *ec* without any periods.

## Navigating the error display

An active error changes the alphanumeric display to *Er* and activates the error menu. The push button functions are now dedicated to error displays.

For example, should the following conditions exist:

- There is a high temperature CRITICAL condition for the disk drive in bay 9.
- There is a EMU NVRAM write failure NONCRITICAL condition.

As soon as one of these conditions is reported the alphanumeric display is Er, the top push button LED is On, and the audible alarm is beeping three times per cycle.

Complete the following procedure to analyze the disk drive condition report.

1. To move from the error display to the element type, press and hold the top push button until the element type is displayed.

   **NOTE:**

   The display will first move to the element type display, then to the element number, then to the error code.

2. Release the top push button when the element type is displayed. The display has both decimal points lit.
3. Press and release the top push button again to move to the element number. This display has only the right decimal point lt.
4. Press and release the top button again to move to the error code. This display has no decimal points lit. Repeated press/release operations will cycle through these three values.
5. Press and hold the top push button from any of the three display states in step 3 to move to the element type for a new alarm.
6. Additional press/release operations cycle through the element type, element number, and error code.

**NOTE:**

Pressing and releasing the bottom push button allows you to move from the element type display, the element number display, or the error code display directly to the *Er* display.

### Condition report analysis

As described in Appendix B: EMU Generated Condition Reports, condition report analysis involves:

1. Identifying the element.
2. Determining the major problem.
3. Defining additional problem information.

## Viewing the reporting group feature

Another function of the enclosure address bus is to provide communications within a reporting group. A Reporting Group (rG) is an HSV110 controller pair and the associated drive enclosures. The controller pair automatically assigns a unique (decimal) four-digit Reporting Group Number (RGN) to each EMU on an FC-AL.

Each of the drive enclosures on a loop pair are in one reporting group:

- All of the drive enclosures on loop pair 1, both loop 1A and loop 1B, share a unique reporting group number.
- All of the drive enclosures on loop pair 2, both loop 2A and loop 2B, share a unique reporting group number.

Each EMU collects environmental information from the associated enclosure and broadcasts the information to reporting group members using the enclosure address bus. Information from enclosures in other reporting groups is ignored.

### Reporting group numbers

The reporting group number (RGN) range is 0000 through 4099, decimal.

- *0000* is reserved for enclosures that are not part of any reporting group.
- *0001* through *0015* are RGNs reserved for use by the EMU.
- *0016* through *4095* are valid RGNs.
- *4096* through *4099* are invalid RGNs.

The reporting group numbers are displayed on the EMU alphanumeric display as a pair of two-digit displays. These two displays are identified as *rH* and *rL*.

- Valid *rH* displays are in the range *00* through *40*, and represent the high-order (most significant) two digits of the RGN.
- Valid *rL* displays are in the range *00* through *99*, and represent the low-order (least significant) two digits of the RGN.

Viewing a reporting group number

To view a reporting group number:

1. Press and release the bottom push button until the alphanumeric display is *rG*.
2. To display the two most significant digits of the Reporting Group Number, press and hold the top push button unit the display is *rH*.
3. Press and release the top push button to display the first two digits of the RGN.
4. Press and release the top push button until the alphanumeric display is *rH*.

5. Press and hold the top push button until the alphanumeric display is *rL*.
6. Press and release the top push button to display the last two digits of the Reporting Group Number.
7. To exit the display, press and release the bottom push button until the alphanumeric display is *rG*.

## Verifying enclosure operation

Check the enclosure status LEDs in the front, lower right corner (see Figure 56). If the display is not exactly as shown, an error condition exists. To determine the defective element, check the drive status LEDs on the front, the EMU, the power supplies, and the blowers, as well as checking the I/O module status LEDs on the rear (see Table 17).

Either of the drive displays in Figure 56 indicates a properly functioning disk.

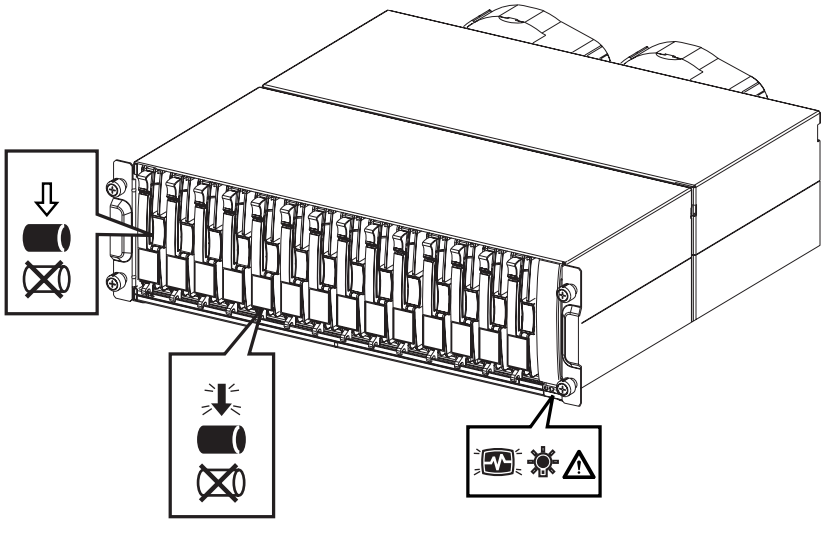



**Figure 56 Typical operational LED status displays—enclosure front**

Figure 57 shows the location of the status displays. See Table 17 for state descriptions of the status LEDs.

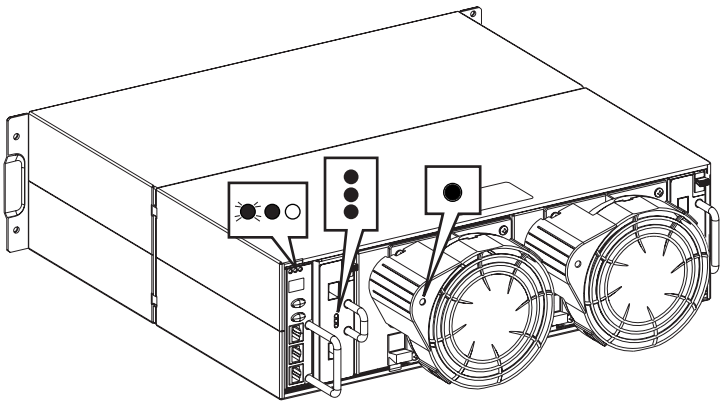



**Figure 57 Location of LED status displays—enclosure rear**

**Table 17 LED status displays**

| | |
|---|---|
| **EMU LEDs and icons** | The enclosure power (both the +5 VDC and +12 VDC) is present and correct. There are NO enclosure faults |
| **I/O module A and I/O module B LEDs** | For information about I/O Module LED status displays, see I/O Module Status Displays. |
| **Power supply and blower LEDs** | Both the power supply and the blower are operational. |

## Status monitoring and display

The major status monitoring capabilities of these enclosures include:

- Displaying the enclosure status on the enclosure icons
- Displaying the blower, power supply, EMU, drive, and I/O module status on the element LEDs
- Detecting the installation of blowers, power supplies, drives, or I/O modules
- Detecting the removal of blowers, power supplies, drives, or I/O module
- Sensing enclosure internal temperatures
- Sensing power supply voltage, current, and total power
- Sensing ambient temperature

**NOTE:**

The ambient temperature is the temperature at the enclosure air intake, or the room temperature.

## Enclosure status icons

The enclosure status LEDs are located on the enclosure backplane. These LEDs illuminate the status icons (see Table 18) in the front, lower right corner of the enclosures (see Figure 56)

**Table 18 Enclosure status icon displays**

| Icon | Off | On | Flashing |
|---|---|---|---|
| EMU "Heartbeat" Icon (green LED) |  |  |  |
| Power Icon (green LED) |  |  |  |
| Enclosure Status Icon (orange LED) |  |  |  |

# Fibre Channel loop switches

The EVA 5000 uses four FC loop switches (Figure 58) to connect all of the drive enclosures to the controller pair using FC cables. Each switch acts as a central point of interconnection and establishes a fault-tolerant physical loop topology.

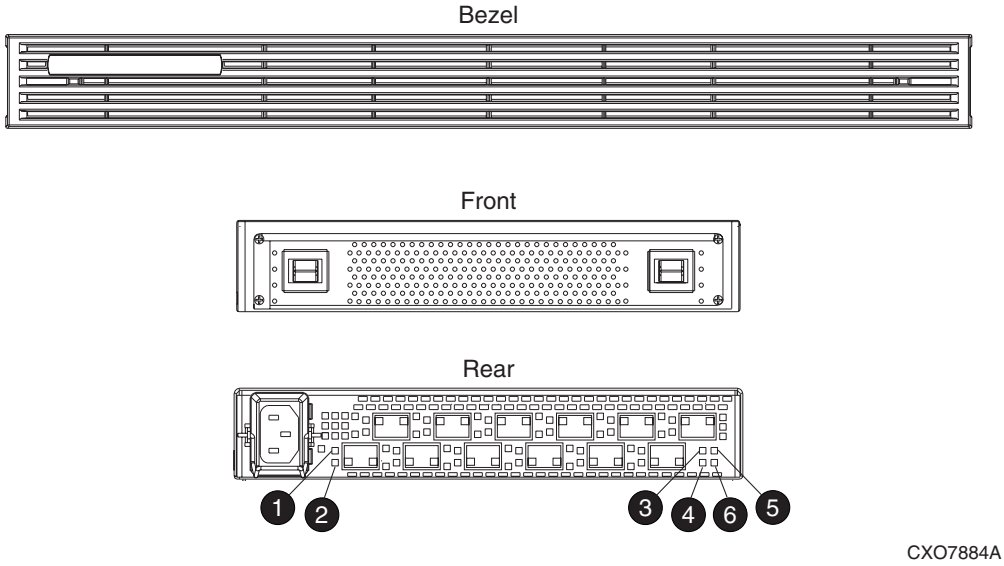



**Figure 58 FC loop switch**

1. SFP Status LED
2. Port Bypassed LED
3. POST Fault LED
4. Over Temp LED
5. Power LED
6. Loop Operational LED

## Power-on self test

When you power On the Fibre Channel switch, it performs a Power-On Self Test (POST). A POST verifies that the switch is functioning properly. During a POST, all of the LEDs turn On for approximately two seconds. Then, all of the LEDs, except the Power LED, turn Off.

If the Port Bypass LEDs are blinking at a constant rate and the POST Fault LED is On, the switch detected a fault during the POST. When a POST detects a fault, contact your authorized service representative.

## Reading the switch LEDs

The Fibre Channel switch contains both system LEDs and port LEDs. The system LEDs indicate the status of the switch, and the port LEDs provide status of a specific port. Figure 59 shows the Fibre Channel switch with the system and port LEDs.

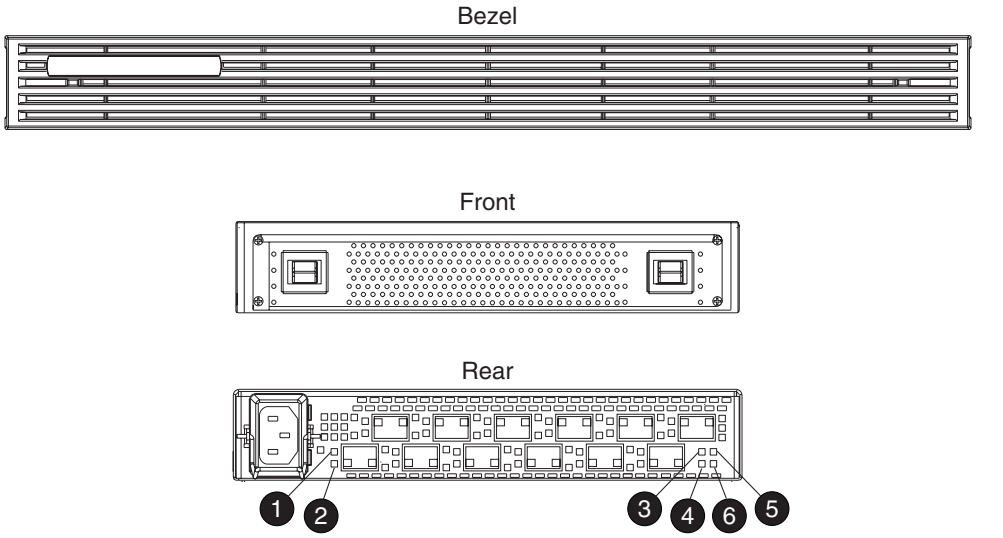



**Figure 59 Fibre Channel switch LEDs**

1. SFP Status LED
2. Port Bypassed LED
3. POST Fault LED
4. Over Temp LED
5. Power LED
6. Loop Operational LED

Table 19 describes the system LEDs.

**Table 19 Fibre Channel switch system LEDs**

| System LED | Description |
|---|---|
| Power | A green LED. When lit, this LED indicates that the switch is plugged in and the internal power is functional. |
| Loop Operational | A green LED. When lit, this LED indicates that the Fibre Channel loop has completed initialization and is now operational. |
| POST Fault | An amber LED. When lit, this LED indicates that the internal hardware self-test failed and the switch will not function. |
| Over Temp | An amber LED. When lit, this LED indicates that the ambient temperature has exceeded 45 °C. The switch is still functional; however you should correct the problem immediately. The Over Temp LED turns off when the problem is corrected. |

Table 20 describes the port LEDs.

**Table 20 Fibre Channel switch port LEDs**

| SFP status LEDGreen | Port bypassed LED amber | Description |
|---|---|---|
| Off | Off | Indicates that the port does not have an SFP installed and is bypassed by the loop. |
| On | Off | Indicates that the port is operating normally. The port and device are fully operational. |
| On | On | Indicates the that port is in a bypassed state. The port is non-operational due to loss of signal, poor signal integrity, or the Loop Initialization Procedure (LIP).NOTE: This condition is also normal when the SFP is present but not attached to an FC-AL node or when the SFP is present and attached to only a cable assembly. Attaching the SFP to a device and plugging it into the port should initiate the LIP by the attached device. |
| Off | On | Indicates a Tx fault. The port is non-operational due to an SFP transmitter fault, improperly-seated SFP, or another failed device. |

## Problem isolation

Table 21 lists several basic problems and their solutions.

**Table 21 Fibre Channel switch basic troubleshooting**

| Problem | Recommended action |
|---|---|
| SFPs are installed in ports but no LEDs are lit. | 1. Verify that the power cord is firmly seated in the switch and is connected to the power outlet.2. Check the power LED to verify that the switch is on. |
| SFP is installed, but the Port Bypassed LED is lit. | Re-seat the SFP. If the same condition occurs, the SFP is probably faulty and should be replaced. |
| SFP is installed, but the SFP Status LED and the Port Bypassed LED are lit. | This condition indicates that the switch is not receiving a valid Fibre Channel signal or that the switch is receiving an LIP.1. Ensure that the switch is powered on.2. Contact your authorized service representative for furter assistance. |
| SFP is installed and the SFP Status LED is lit, but the devices are not communicating. | This condition indicates that the switch is receiving a valid Fibre Channel signal, but there are no upper level protocols active.1. Verify that you are running the correct firmware on all storage system hardware.2. Check the Loop Operational LED.a. If the Loop Operational LED is lit, the devices have completed initialization.b. If the Loop Operational LED is off, the devices were not initialized. Disconnect the devices from the switch. Reconnect the devices one at a time. This allows you to isolate the device that is responsible for the loop failure.3. Contact your authorized service representative for further assistance. |

# HSV controllers

This section describes the major features, purpose, and function of the HSV110 and HSV100 controllers. Each Enterprise Virtual Array has a pair of these controllers. Figure 60 shows the HSV110 controller.

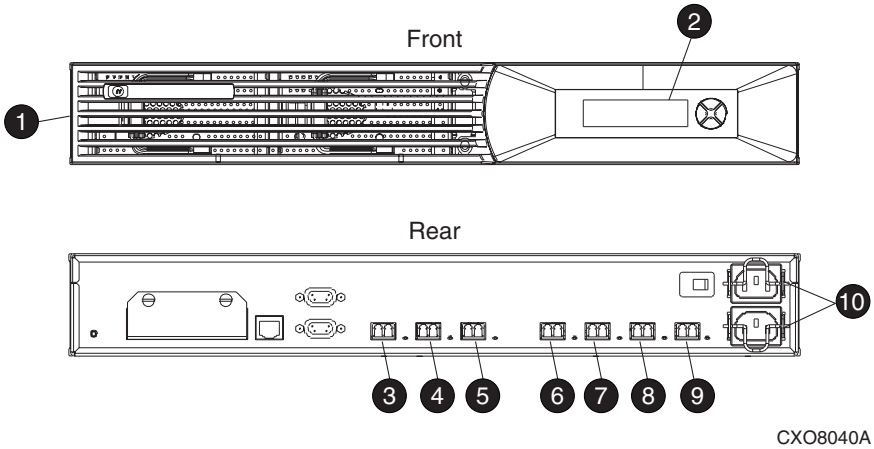



**Figure 60 HSV110 controller—front and rear views**

1. Bezel
2. OCP
3. HF1 port
4. HF2 port
5. Mirror port
6. 1B port
7. 2B port

8. 1A port
9. 2A port
10. Power input

## High availability features

Two interconnected controllers ensures that the failure of a controller element (such as a power supply, transceiver, fiber optic or copper Fibre Channel cable, Fibre Channel port, and so forth) does not disable the system. For EVA5000 configurations, the complete data redundancy configuration includes two Loop A and two Loop B data paths. For EVA3000 configurations, data redundancy is accomplished with two Loop A data paths.

A single controller can fully support an entire system until the defective controller, or controller element, is repaired.

If a blower fails, it can be replaced without shutting down the system.

Each HSV110 controller has two lead-acid cache battery assemblies that provide power to the cache memory dual in-line memory modules (DIMMs). Each battery assembly has three lead-acid, nonspillable cells. When both battery assemblies are fully charged, they can provide power to the DIMMs for up to 96 hours.

## Operator control panel

The OCP (see Figure 61) is an interface between you and the controller. Much of the information provided here duplicates information displayed on the Command View EVA graphical user interface (GUI). Even if you cannot observe the GUI, or if the GUI is not functioning, the controller status is available on the OCP. You can use the OCP LEDs, the LCD, and the push buttons to determine the controller status.

The OCP displays system information (status and error conditions) and lets you enter data or isolate problems.

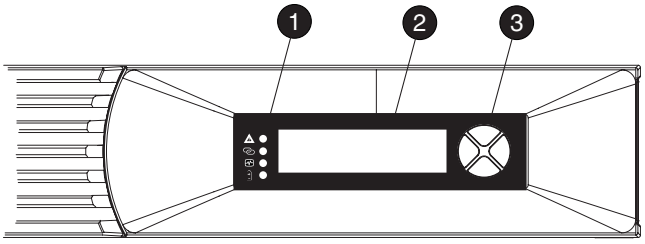



**Figure 61 Controller OCP**

1. Status LEDs (see LEDs)
2. 40–character alphanumeric display (see LEDs)
3. Push buttons (see Displaying the Storage System Menu Tree)

### LEDs

The status LEDs indicate the internal status of the controller, as described in Table 22. During initial setup, the status LEDs might not be fully operational.

The following sections define the alphanumeric displays modes, including the possible displays, the valid LED displays, and the push button functions.

**Table 22 Controller status icons and LEDs**

| Icon | Description |
|---|---|
| Fault LED | When the amber LED to the right of this icon is on or flashing, there is a controller problem. Check either the Command View EVA GUI or the LCD Fault Management displays for a definition of the problem and recommended corrective action. |
| Host Link LED | When the green LED next to this icon is on, there is a link between the storage system and a host. When the red LED next to this icon is on, there is no link between the storage system and a host. |
| Controller LED | When the green LED next to this icon is flashing slowly, a heartbeat, the controller is operating normally. When this LED is not flashing, there is a problem. |
| Cache Battery Assembly LED | When the red LED next to this icon is off, the battery assembly is charged.When this LED is on, the battery assembly is discharged. |

## Navigation push buttons

The information displayed by the OCP, the data you can enter, and the navigation push button functions depend on the alphanumeric display mode.

To simplify presentation and to avoid confusion, the push button reference names, regardless of labels, are *left*, *right*, *top*, and *bottom* (see Figure 62).



**Figure 62 Navigation push button icons**

## LCD

The two LCD rows display up to 20 alphanumeric chracters per row. The LCD alternates between displaying the Storage System Name and the Node World Wide Name (seeFigure 63).

**NOTE:**

An active (flashing) display, an error condition message, or a user entry (pressing a push button) overrides the default display. When none of these conditions exist, the default display is active after approximately 15 seconds.

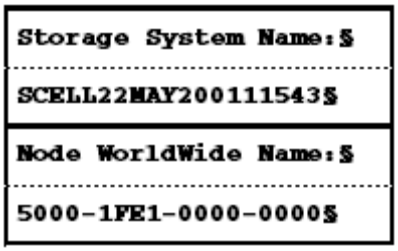



**Figure 63 Default LCD display**

## Displaying the storage system menu tree

The Storage System Menu Tree lets you select information to be displayed (for example, System Information, Fault Management) or select procedures to implement (Shutdown System, System Password). To display this tree, press any push button (▲, ▼, ◀, or ▶) when either of the default displays is active.

- When you select either System Information or Fault Management, you can display, but not change, product information.
- Selecting Shutdown System lets you implement the procedure for shutting down the system in a logical, sequential manner. Using the Shutdown System procedure maintains data integrity and avoids the possibility of losing or corrupting data.
- Selecting System Password lets you create a system password to ensure that only authorized personnel can modify system operation and functions from Command View EVA.

Use the following procedure to select and navigate the storage system menu tree.

1. The default display alternates between the Storage System Name display and the Node WorldWide Name display.

   Push any push button to return to the Storage System Menu Tree display.
2. System Information is the active display.

   Press ▼ to sequence down through the tree.

   Press ▲ to sequence up through the tree.

   Press ▶ to select an active display.

   Press ◀ to return t the default display.

The following table displays all menu options within the OCP display:

**Table 23 Menu options within the OCP display**

| Menu Options | Information | Fault Management | Shutdown Options | System Password |
|---|---|---|---|---|
| | Port Config | Last Fault | Restart | Change Password |
| | UUID Unique Half | Detail View | Power Off | Clear Password |
| | Controller Versions | | System Uninitialize | Current Password |
| | Debug Flags | | | |
| | Unbypass Loops | | | |
| | Print Flags | | | |

**NOTE:**

To escape any menu, press ◀ or wait 5 seconds for the OCP display to revert back to the root display of the Storage System Name and Node Worldwide Name.

**NOTE:**

Flashing text on the OCP display indicates the menu option is available for selection.

## Displaying system information

**NOTE:**

The purpose of this information is to assist the authorized service representative when servicing your system.

The system information displays show the system configuration including the VCS version, the OCP firmware and application programming interface (API) versions, and the enclosure address bus programmable integrated circuit (PIC) configuration. You can only view, not change, this information.

When there is no activity for approximately 15 seconds, the display automatically returns to the default display.

**NOTE:**

Activity is either an active error report or pressing a push button.

System information functions defines the push button functions.

**Table 24 System information functions**

| Button | Function |
|---|---|
| ▼ | From the default display, moves from System Info to Fault Management to Shutdown Options to System Password |
| ▲ | Moves back through the main menu items. |
| ▶ | Moves through sub-menu items. |
| ◀ | Moves back through sub-menu items. |

## Displaying Versions system information

When you press ▼, the active display is Versions. From the Versions display you can determine the:

- VCS revision level
- OCP firmware revision level
- PIC (Programmable Integrated Circuit) firmware revision level for:
  - Address Bus PIC
  - Battery PIC
  - Power PC Processor
  - Quasar

**NOTE:**

The terms PIC, PowerPC Processor, Quasar, glue FPGA, and Surge are for development purposes and have no significance for normal operation.

If the requested version information is not available, the display is always `NOT AVAILABLE`.

**NOTE:**

When viewing the software or firmware version information, pressing ◀ displays the Versions Menu tree.

To display System Information

1. The default display alternates between the Storage System Name display and the Node World Wide Name display.

   Press any push button to select the Storage System Menu Tree display.
2. Press ▶ to select the Information menu.
3. Press ▼ to scroll to Controller Versions.
4. Press ▶ to select the Master Version menu or Slave Version menu. If you are operating the master controller, the Master Version menu is displayed. If you are operating the slave controller, the Slave Version menu is displayed.
5. Press ▶ to display the VCS version.
6. Press ◀ to display the Versions Menu tree.
7. Press ▼ to scroll to the OCP Firmware.
8. Press ▶ to display the OCP Firmware.
9. Press ◀ to display the Versions Menu tree.
10. Press ▼ to scroll to the OCP Menu.
11. Press ▶ to display the OCP Menu.
12. Press ◀ to display the Versions Menu tree.
13. Press ▼ to scroll to the Address Bus PIC.
14. Press ▶ to display the Address Bus PIC.
15. Press ◀ to display the Versions Menu tree.
16. Press ▼ to scroll to the Battery PIC.
17. Press ▶ to display the Battery PIC.
18. Press ◀ to display the Versions Menu tree.
19. Press ▼ to scroll to the PowerPC Processor.
20. Press ▶ to display the PowerPC Processor.
21. Press ◀ to display the Versions Menu tree.
22. Press ▼ to scroll to the Quasar version.
23. Press ▶ to display the Quasar version.
24. Press ◀ to display the Versions Menu tree.

## Shutting down the system

△ CAUTION:

To power off the system for more than 96 hours, use Command View EVA.

You can use the shutdown system function to implement the following shutdown methods: (see Table 25)

- Restarting the system (see Restarting the System).
- Turning off the power (see Powering Off the System).
- Uninitializing the system (see Uninitializing the System).

To ensure that you do not mistakenly activate a shutdown procedure, the default state is always NO, indicating *do not implement this procedure*. Implementing any shutdown method requires you to complete at least two actions.

**Table 25 Shutdown methods**

| LCD prompt | Description |
|---|---|
| RESTART | Implementing this procedure establishes communications between the storage system and Command View EVA. This procedure is used to restore the controller to an operational state where it can communicate with Command View EVA |
| POWER OFF | Implementing this procedure initiates the sequential removal of controller power. This ensures no data is lost. The reasons for implementing this procedure include replacing a disk drive enclosure. |
| SYSTEM UNINITIALIZE | Implementing this procedure will cause the loss of all data. For a detailed discussion of this procedure, see Uninitializing the System. |

## Shutting the controller down using the LCD menu

Use the following procedure to select the Shutdown System display and execute a shutdown procedure.

NOTE:

Command View EVA is the preferred method for shutting down the controller. Shut down the controller from the OCP only if Command View EVA cannot communicate with the controller.

Shutting down the controller from the OCP removes power from the controller on which the procedure is performed only. To restre power, toggle the controller's power switch.

△ CAUTION:

If you decide NOT to Power Off while working in the Power Off menu, the Power Off System NO option must be displayed before you press the ESC (◀) pushbutton to avoid the powerdown.

1. Press ▼ to scroll to the Shutdown Options menu.
2. Press ▶ to select the Shutdown Options menu.
3. Press ▼ to scroll to Power Off.
4. Press ▶ to select Power Off.
5. Power Off System NO is displayed. Press ◀ to accept NO. Press ▼ to display Power Off System YES.

6. Press ◀ to accept YES.
7. Press ▶ to go to `POWER OFF SYSTEM`.

Once you have selected the Shutdown System function, you can select and execute a shutdown method as described in the following sections.

## Restarting the system

To restore the controller to an operational state, use the following procedure to restart the system.

1. Press ▼ to scroll to the Shutdown Options menu.
2. Press ▶ to select the Shutdown Options menu.
3. Press ▶ to select Restart.
4. Press ▶ to display `RESTART SYSTEM NO`.

   Press ▼ to scroll to Power Off.
5. Press ◀ to accept `NO`.

   Press ▼ to scroll to `RESTART SYSTEM YES`.
6. Press ◀ to accept `YES` and to go toHSV110 Startup.
7. No user input is required. The system will automatically initiate the startup procedure and proceed to load the Storage System Name and Node WorldWide Name information from the operational controller.

## Powering off the system

Use the following procedure to remove power from the controller pair, save the data, and remove the storage system from Command View EVA.

**NOTE:**

Implementing this procedure removes power from the controller pair and all associated drive shelves. To restore power to the controller system, you must cycle both PDU breakers in the enclosure.

1. Press ▼ to scroll to the Shutdown Options menu.
2. Press ▶ to select the Shutdown Options menu.
3. Press ▶ to select Restart.
4. Press ▼ to scroll to `Power Off`.
5. Press ▶ to select `POWER OFF SYSTEM`.
6. Press ◀ to accept `NO`.

   Press ▼ to scroll to `POWER OFF SYSTEM YES`.
7. Press ◀ to accept `YES`.

   Press ▲ to select `NO`.

## Uninitializing the system

Uninitializing the system is another way to shut down the system. This action causes the loss of all storage system data. Since Command View EVA cannot communicate with the disk drive enclosures, the stored data cannot be accessed. This destroys the storage system and all the data.

△ CAUTION:

Uninitializing the system destroys all user data. Any data stored on the system will be permanently destroyed. The WWN will remain in the controller unless both controllers are powered off. The password will be lost. If the controllers remain powered on until you create another storage system (initialize via GUI), you will not have to re-enter the WWN.

Use the following procedure to uninitialize the system

1. Press ▼ to scroll to the Shutdown Options menu.
2. Press ▶ to select the Shutdown Options menu.
3. Press ▼ to scroll to Uninitialize System.
4. Press ▶ to select Uninitialize System.
5. Press ▶ to select `UNINITIALIZE SYSTEM NO`.
6. Press ◀ to accept `NO`

   OR

   press ▼ to scroll to `UNINITIALIZE SYSTEM YES`.
7. Press ◀ to accept `YES`. `REALLY UNINIT SYSTEM NO` is now displayed.
8. Press ◀ to accept `NO`

   OR

   press ▼ to display `REALLY UNINIT SYSTEM YES`.
9. Press ◀ to accept `YES`

   OR

   press ▲ to display `REALLY UNINIT SYSTEM NO`.
10. Press ◀ to accept `NO`

    OR

    press ▼ to display `PROCEED YES`.
11. Press ◀ to accept `YES`

    OR

    press ▲ to display `PROCEED NO`.
12. The system is uninitialized.

## Password options

The password entry options are:

- Entering a password during storage system initialization (see Setting Up an HSV110-Series Controller Pair Using the OCP).
- Showing the current passwod. The actual password is not displayed, instead an indicator informs you of whether a password has been set.
- Changing a password (see Changing a Password).
- Removing password protection (see Clearing a Password).

## Changing a password

For security reasons, you may need to change a storage system password. First you must select a new, unique, eight-character password, using the uppercase letters A through Z and the lowercase letters a through z.

After selecting the new password, use the following procedure to change the password.

**NOTE:**

Changing a system password on the controller requires changing the password on any Command View EVA with access to this system.

1. Press ▼ to scroll to the System Password menu.
2. Press ▶ to select the System Password menu.
3. Press ▶ to select `Change Password`

   OR

   press ▲ to go to `Shutdown Options`.
4. Press ▶ to select, `CHANGE PASSWORD NO`

   OR

   press ▼ to scroll to `Clear Password`.
5. Press ◀ to accept `NO`

   OR

   press ▼ to scroll to `CHANGE PASSWORD YES`.
6. Press◀ to accept `YES`

   OR

   press ▲ to scroll to `CHANGE PASSWORD NO`.
7. To enter the first character, press either ▲ or ▼ to select an uppercase or lowercase character.

   Press ▶ to accept a character and select the next password character. The character display changes to an asterisk.
8. Repeat step 7 for the remaining seven characters.

   Press ◀ to accept the password and go to `CHANGE PASSWORD YES`.
9. Press ◀ to go to computeroutput>System Password.
10. The system will automatically return to the default display.

## Clearing a password

Use the following procedure to remove storage system password protection.

**NOTE:**

Changing a system password on the controller requires changing the password on any element manager with access to this system.

1. Press ▼ to scroll tot he System Password menu.

2. Press ▶ to select the System Password menu.
3. Press ▼ to scroll to Clear Password.
4. Press ▶ to select Clear Password

   OR

   press ▲ to go to `Shutdown Options`.
5. Press ◀ to keep the password

   OR

   press ▼ to scroll to `CLEAR PASSWORD YES`.
6. Press ◀ to clear the password

   OR

   press ▲ to keep the current password and go to `CLEAR PASSWORD NO`.
7. The system will automatically return to the default display.

## Setting up a controller pair using the OCP

For information about how to set up a controller pair during initial installation see Setting Up a Controller Pair Using the OCP.

# HSV controller cabling

All data cables and power cables attach to the rear of the HSV110 controller (see Figure 64). Adjacent to each data connector (see 3, 4, 5, 6, 7, 8, and 9) is a two-colored LED that indicates the link status.

- When the green LED is on, the link can communicate.
- When the amber LED is on, the link cannot communicate.

**NOTE:**

These LEDs do not indicate whether there is communication on the link, only whether the link can transmit and receive data.

The data connections are the intefaces to the disk drive enclosures or loop switches (depending on your configuration), the other controller, and the fabric. Fiber optic cables link the controllers to the fabric, and, if an expansion cabinet is part of the configuration, link the expansion cabinet drive enclosures to the loop switches in the main cabinet. Copper cables are used between the controllers (mirror port) and between the controllers and the drive enclosures or loop switches.

**NOTE:**

In Figure 64, the connectors are identified by the label printed on the controller. The numbered item captions define the connector function.

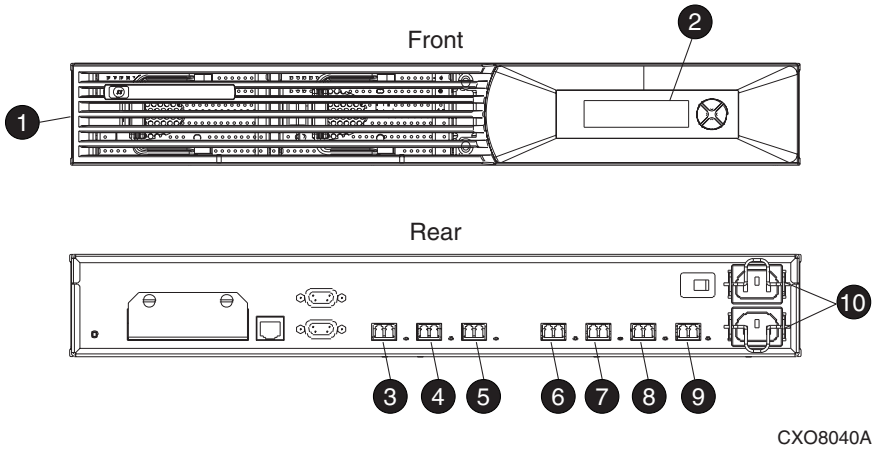



**Figure 64 HSV110-series controller—front and rear views**

1. Bezel
2. OCP
3. HF1 port
4. HF2 port
5. Mirror port
6. 1B port
7. 2B port (EVA 5000 only)
8. 1A port
9. 2A port (EVA 5000 only)
10. Power input

HSV100 controllers use copper fiber channel cables, while HSV110 controller use fiber optic fiber channel cables.

# Racks

Each rack has four feet and four casters. Raising the adjustable feet places the rack weight on the casters, so you can easily move the rack. Lowering the feet places the rack weight on the feet and prevents the rack from moving. The removable front and rear doors, and the removable side panels provide easy access to the rack interior.

Each configuration has an upper and lower controller enclosure (the controller pair), drive enclosures, and an expansion bulkhead. Each controller pair and all the associated drive enclosures form a single storage system.

## Rack configurations

Each system configuration depends on the following factors:

- The controller pair (Model HSV110)
- The number of 3U Fibre Channel drive enclosures per rack

For more information about racks and configurations, including expansion and interconnection, refer to the *HP StorageWorks Enterprise Virtual Array Hardware Configuration Guide*.

## Power distribution

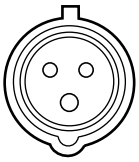
AC power is distributed to the rack through a dual Power Distribution Unit (PDU) assembly mounted at the bottom rear of the rack. The characteristics of the fully-redundant rack power configuration are as follows:

- Each PDU is connected to a separate circuit-breaker-protected, 30-A AC site power source (220–240 VAC ±10%, 50 or 60 Hz, ±5%). Figure 65 illustrates the compatible 60-Hz and 50-Hz wall receptacles.



CXO7549A

NEMA L6-30R receptacle, 3-wire, 30-A, 60-Hz



CXO5409B

IEC 309 receptacle, 3-wire, 30-A, 50-Hz

**Figure 65 60-Hz and 50-Hz wall receptacles**

- The standard power configuration for any Enterprise Virtual Array rack is the fully redundant configuration. Implementing this configuration requires:
  - Two separate circuit-breaker-protected, 30-A site power sources with a compatible wall receptacle (see Figure 65).
  - One dual PDU assembly. Each PDU connects to a different wall receptacle.
  - Eight Power Distribution Modules (PDM) per rack. Four PDMs mount vertically on each side of the rack. Each set of four PDMs connects to a different PDU.
  - The drive enclosure power supplies on the left (PS 1) connect to the PDMs on the left with a gray, 66 cm (26 in) power cord.
  - The drive enclosure power supplies on the right (PS 2) connect to the PDMs on the right with a black, 66 cm (26 in) power cord.
  - The upper controller connects to a PDM on the left with a gray, 152 cm (60 in) power cord.
  - The lower controller connects to a PDM on the right with a black, 66 cm (26 in) power cord.

**NOTE:**

Drive enclosures, when purchased separately, include one 202 cm (80 in) black cable and one 202 cm (80 in) gray cable.

The configuration provides complete power redundancy and eliminates all single points of failure for both the AC and DC power distribution.

## PDUs

Each Enterprise Virtual Array rack has either a 50- or 60-Hz, dual PDU mounted at the bottom rear of the rack. The 30–56205–03/30–56205–04 PDU placement is side-by-side. The 228481–002/228481–003 PDU placement is back-to-back, plugs facing out.

- The standard 50-Hz PDU cable has an IEC 309, 3-wire, 30-A, 50-Hz connector.
- The standard 60-Hz PDU cable has a NEMA L6-30P, 3-wire, 30-A, 60-Hz connector.

If these connectors are not compatible with the site power distribution, you must replace the PDU power cord cable connector.

Each of the two PDU power cables has an AC power source specific connector. The circuit-breaker-controlled PDU outputs are routed to a group of four AC receptacles (see Figure 66). The

voltages are then routed to PDMs, sometimes referred to as AC power strips, mounted on the two vertical rails in the rear of the rack.

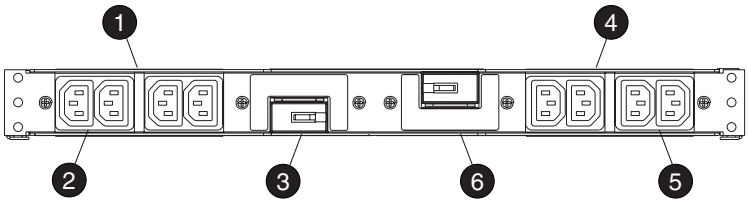



**Figure 66 Dual PDU assembly—top view**

1. PDU 1
2. PDU 1 AC receptacles
3. PDU 1 circuit breaker
4. PDU 2
5. PDU 2 AC receptacles
6. PDU 2 circuit breaker

### PDU 1

PDU 1 connects to AC power distribution source 1. A PDU 1 failure:

- Disables the power distribution circuit.
- Removes power from PDMs 1, 2, 3, and 4.
- Disables PS 1 in the drive enclosures.
- Disables the upper controller power supply.

### PDU 2

PDU 2 connects to AC power distribution source 2. A PDU 2 failure:

- Disables the power ditribution circuit.
- Removes power from PDMs 5, 6, 7, and 8.
- Disables PS 2 in the drive enclosures.
- Disables the lower controller power supply.

### PDU assembly

The dual PDU assembly (see Figure 67) mounts in the lower rear of the rack. This assembly contains two PDUs: PDU 1 and PDU 2 . Each PDU has a 250-VAC, 30-A circuit breaker (6 and 12) and four IEC 320-C13 AC output power receptacles (2 through 5, and 8 through 11). The circuit breakers and AC receptacles are accessible when the PDU assembly is in the upright position.

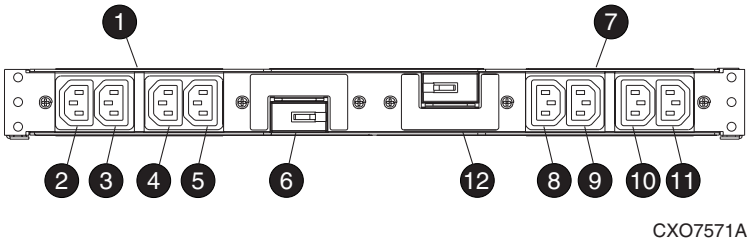



**Figure 67 Dual PDU assembly major components**

1. PDU 1
2. PDU 1 receptacle A

3. PDU 1 receptacle B
4. PDU 1 receptacle C
5. PDU 1 receptacle D
6. PDU 1 circuit breaker
7. PDU 2
8. PDU 2 receptacle A
9. PDU 2 receptacle B
10. PDU 2 receptacle C
11. PDU 2 receptacle D
12. PDU 2 circuit breaker

During normal operation, the hinged PDU assembly is in the upright position and the rear door is closed.

### 228481–002/228481–003 PDU models

The 228481–002/22481–003 PDU models allow for greater customer flexibility. The customer can:

- Use the power cord in any standard electrical outlet.
- Replace with little inconvenience.

The PDU nearest the rear of the rack is PDU 1, the other is PDU 2. See Figure 68 for the this PDU assembly.

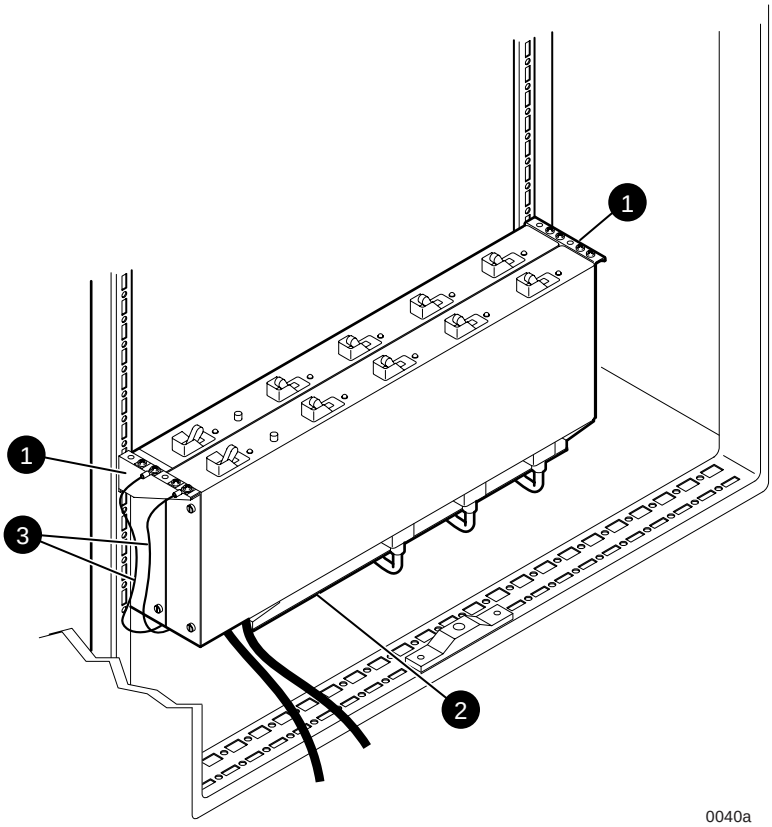



**Figure 68 228481–002/22481–003 PDU assembly**

1. mounting brackets
2. cord retention brackets
3. grounding cables

## PDMs

There are eight PDMs mounted in the rear of each rack:

- Four mounted on the left vertical rail connect to PDU 1.
- Four mounted on the right vertical rail connected to PDU 2.

Each PDM has six AC receptacles and two thermal circuit breakers. The PDMs distribute the AC power from the PDUs to the enclosures. Two power sources exist for each controller pair and drive enclosure. If a PDU fails, the system will remain operational.

△ CAUTION:

The AC power distribution within a rack ensures a balanced load to each PDU and reduces the possibility of an overload condition. Changing the cabling to or from a PDM could cause an overload condition. HP supports only the AC power distributions defined in this user guide.

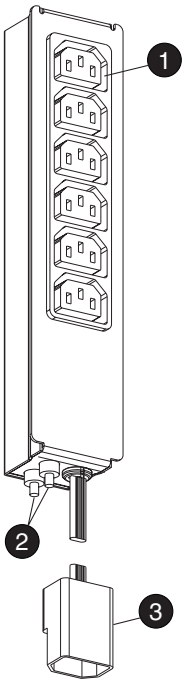



**Figure 69 Rack PDM**

1. Power receptacles
2. Thermal circuit breakers
3. IEC309 AC power connector

### 252638–001 PDM model

The 339388–001 PDM mounting brackets are assembled at the top and bottom of each 252638-001 PDM and attach to the rack with either a right- or left-side orientation. See Rack-mounted 252638-001 PDM for this PDM assembly.

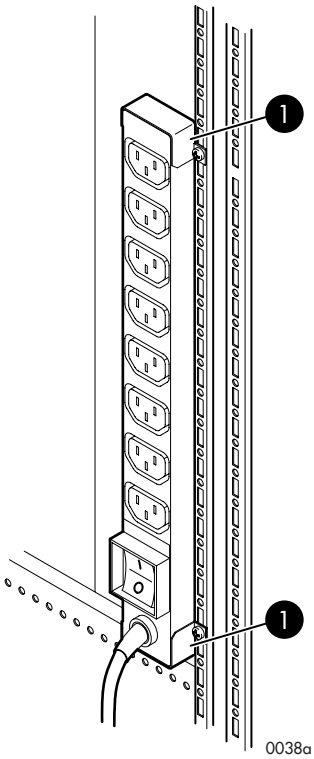



**Figure 70 Rack-mounted 252638–001 PDM**

1. PDM mounting brackets, right-side orientation.

## Rack AC power distribution

The power distribution in an Enterprise Virtual Array rack is the same for all variants. The site AC input voltage is routed to the dual PDU assembly mounted in the rack lower rear. Each PDU distributes AC to a maximum of four PDMs mounted on the left and right vertical rails (see Figure 71).

- PDMs 1 through 4 connect to receptacles A through D on PDU 1. *Grey* power cords connect these PDMs to the number 1 drive enclosure power supplies and to the *upper controller enclosure*.
- PDMs 5 through 8 connect to receptacles A through D on PDU 2. *Black* power cords connect these PDMs to the number 2 drive enclosure power supplies and to the *lower controller enclosure*.

**NOTE:**

The locations of the PDUs and the PDMs are the same in all racks.

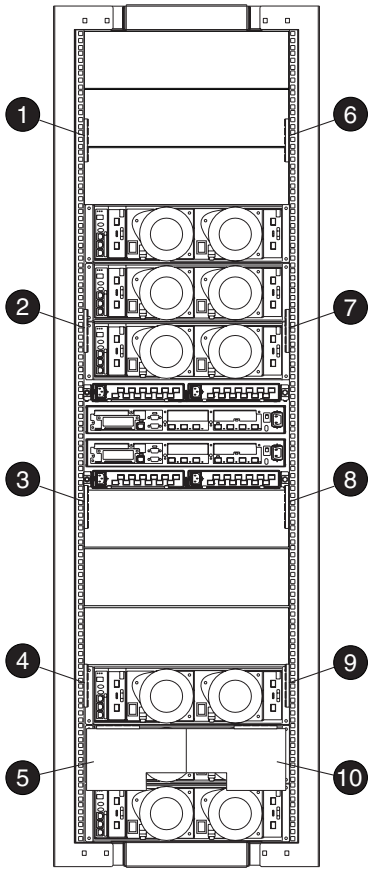



**Figure 71 Rack AC power distribution**

1. PDM 4
2. PDM 3
3. PDM 2
4. PDM 1
5. PDU 1
6. PDU 8
7. PDM 7
8. PDM 6
9. PDM 5
10. PDU 2

## Rack System/E power distribution components

AC power is distributed to the Rack System/E rack through Power Distribution Units (PDU) mounted on the two vertical rails in the rear of the rack. Up to four PDUs can be mounted in the rack—two mounted on the right side of the cabinet and two mounted on the left side.

Each of the PDU power cables has an AC power source specific connector. The circuit-breaker-controlled PDU outputs are routed to a group of ten AC receptacles. The storage system components plug directly into the PDUs.

### Rack AC power distribution

The power distribution configuration in a Rack System/E rack depends on the number of storage systems installed in the rack. If one storage system is installed, only two PDUs are required. If multiple storage systems are installed, four PDUs are required.

The site AC input voltage is routed to each PDU mounted in the rack. Each PDU distributes AC through ten receptacles directly to the storage system components.

- PDUs 1 and 3 (optional) are mounted on the left side of the cabinet. Grey power cords connect these PDUs to the number 1 drive enclosure power supplies and to the controller enclosures.
- PDUs 2 and 4 (optional) are mounted on the right side of the cabinet. Black power cords connect these PDUs to the number 2 drive enclosure power supplies and to the controller enclosures.

## Moving and stabilizing a rack

**⚠ WARNING!**

The physical size and weight of the rack requires a minimum of two people to move. If one person tries to move the rack, injury may occur.

To nsure stability of the rack, always push on the lower half of the rack. Be especially careful when moving the rack over any bump (for example: door sills, ramp edges, carpet edges, or elevator openings). When the rack is moved over a bump, there is a potential for it to tip over.

Moving the rack requires a clear, uncarpeted pathway that is at least 80 cm (31.5 in) wide for the 60.3 cm (23.7 in) wide, 42U rack. A vertical clearance of 203.2 cm (80 in) should ensure sufficient clearance for the 200 cm (78.7 in) high, 42U rack.

**⚠ CAUTION:**

Ensure that no vertical or horizontal restrictions exist that would prevent rack movement without damaging the rack.

Make sure that all four leveler feet are in the fully raised position. This process will ensure that the casters support the rack weight and the feet do no impede movement.

Each 10000-Series rack requires an area 600 mm (23.62 in) wide and 1000 mm (39.37 in) deep (see Figure 72).

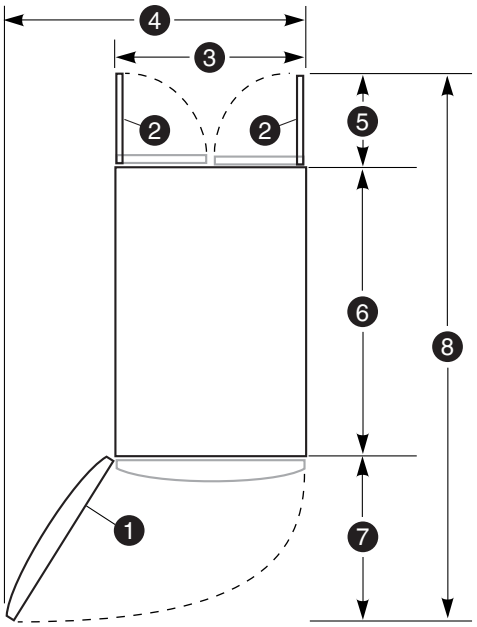



**Figure 72 10000-Series single rack configuration floor space requirements**

1. Front door
2. Rear door
3. Rack width 600 mm
4. Service area width 813 mm
5. Rear service area depth 300 mm
6. Rack depth 1000 mm
7. Front service area depth 406 mm
8. Total rack depth 1706 mm

If the feet are not fully raised, complete the following procedure:

1. Raise one foot by turning the leveler foot hex nut counterclockwise until the weight of the rack is fully on the caster (see Figure 73).
2. Repeat Step 1 for the other feet.

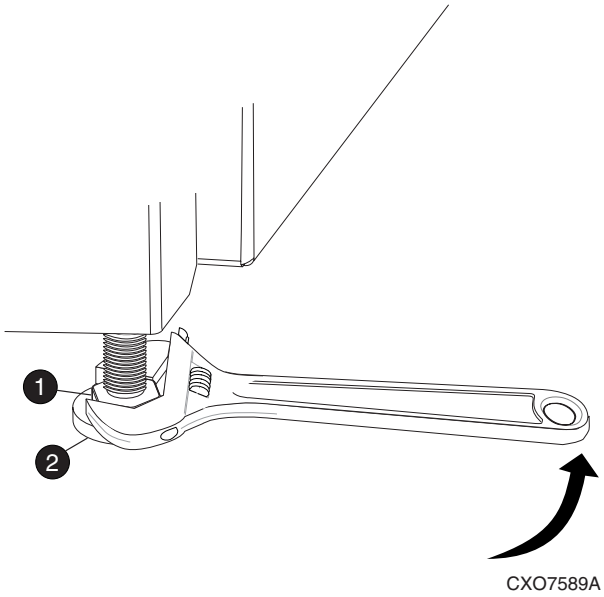



**Figure 73 Raising a leveler foot**

1. Hex nut
2. Leveler foot

3. Carefully move the rack to the installation area and position it to provide the necessary service areas (see Figure 72).

To stabilize the rack when it is in the final installation location:

1. Use a wrench to lower the foot by turning the leveler foot hex nut clockwise until the caster does not touch the floor
2. Repeat step 1 for the other feet.
3. After lowering the feet, check the rack to ensure it is stable and level.
4. Adjust the feet as necessary to ensure the rack is stable and level.

# 5 EVA Best Practices

For the most current best practices information, refer to the *HP StorageWorks Enterprise Virtual Array configuration best practices — white paper* available from http://h71028.www7.hp.com/ERC/downloads/5982-9140EN.pdf.

# A Regulatory notices and specifications

This section provides regulatory notices and specifications for the various components of the Enterprise Virtual Array storage system.

## Regulatory notices

### Federal Communications Commission (FCC) notice

Part 15 of the Federal Communications Commission (FCC) Rules and Regulations has established Radio Frequency (RF) emission limits to provide an interference-free radio frequency spectrum. Many electronic devices, including computers, generate RF energy incidental to their intended function and are, therefore, covered by these rules. These rules place computers and related peripheral devices into two classes, A and B, depending upon their intended installation. Class A devices are those that may reasonably be expected to be installed in a business or commercial environment. Class B devices are those that may reasonably be expected to be installed in a residential environment (for example, personal computers). The FCC requires devices in both classes to bear a label indicating the interference potential of the device as well as additional operating instructions for the user.

The rating label on the device shows the classification (A or B) of the equipment. Class B devices have an FCC logo or FCC ID on the label. Class A devices do not have an FCC logo or FCC ID on the label. After the class of the device is determined, refer to the corresponding statement in the following sections.

### FCC Class A certification

This equipment generates, uses, and may emit radio frequency energy. The equipment has been type tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC rules, which are designed to provide reasonable protection against such radio frequency interference.

Operation of this equipment in a residential area may cause interference, in which case the user at the user's own expense will be required to take whatever measures may be required to correct the interference.

Any modifications to this device—unless approved by the manufacturer—can void the user's authority to operate this equipment under Part 15 of the FCC rules.

**NOTE:**

Additional information on the need to interconnect the device with shielded (data) cables or the need for special devices, such as ferrite beads on cables, is required if such means of interference suppression was used in the qualification test for the device. This information will vary from device to device and needs to be obtined from the HP EMC group.

### Class A equipment

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at personal expense.

## Class B equipment

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit that is different from that to which the receiver is connected.
- Consult the dealer or an experienced radio or television technician for help.

## Declaration of conformity for products marked with the FCC logo, United States only

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

For questions regarding your product, refer to http://tenew.hp.com [http://thenew.hp.com].

For questions regarding this FCC declaration, contact:

- Hewlett-Packard CompanyProduct Regulations Manager3000 Hanover St.Palo Alto, CA 94304
- Or call 1-650-857-1501

To identify this product, refer to the part, series, or model number found on the product.

## Modifications

The FCC requires the user to be notified that any changes or modifications made to this device that are not expressly approved by Hewlett-Packard Company may void the user's authority to operate the equipment.

## Cables

Connections to this device must be made with shielded cables with metallic RFI/EMI connector hoods in order to maintain compliance with FCC Rules and Regulations.

# Laser device

All Hewlett-Packard systems equipped with a laser device comply with safety standards, including International Electrotechnical Commission (IEC) 825. With specific regard to the laser, the equipment complies with laser product performance standards set by government agencies as a Class 1 laser product. The product does not emit hazardous light; the beam is totally enclosed during all modes of customer operation and maintenance.

## Laser safety warnings

Heed the following warning:

⚠ WARNING!

**WARNING**: To reduce the risk of exposure to hazardous radiation:

- Do not try to open the laser device enclosure. There are no user-serviceable components inside.
- Do not operate controls, make adjustments, or perform procedures to the laser device other than those specified herein.
- Allow only HP authorized service technicians to repair the laser device.

### Compliance with CDRH regulations

The Center for Devices and Radiological Health (CDRH) of the U.S. Food and Drug Administration implemented regulations for laser products on August 2, 1976. These regulations apply to laser products manufactured from August 1, 1976. Compliance is mandatory for products marketed in the United States.

## Certification and classification information

This product contains a laser internal to the Optical Link Module (OLM) for connection to the Fibre communications port.

In the USA, the OLM is certified as a Class 1 laser product conforming to the requirements contained in the Department of Health and Human Services (DHHS) regulation 21 CFR, Subchapter J. The certification is indicated by a label on the plastic OLM housing.

Outside the USA, the OLM is certified as a Class 1 laser product conforming to the requirements contained in IEC 825-1:1993 and EN 60825-1:1994, including Amendment 11:1996.

The OLM includes the following certifications:

- UL Recognized Component (USA)
- CSA Certified Component (Canada)
- TUV Certified Component (European Union)
- CB Certificate (Worldwide)

## Canadien notice (avis Canadien)

### Class A equipment

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

### Class B equipment

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

## European union notice

Products with the CE Marking comply with both the EMC Directive (89/336/EEC) and the Low Voltage Directive (73/23/EEC) issued by the Commission of the European Community.

Compliance with these directives implies conformity to the following European Norms (the equivalent international standards are in parenthesis):

- EN55022 (CISPR 22) - Electromagnetic Interference
- EN55024 (IEC61000-4-2, 3, 4, 5, 6, 8, 11) - Electromagnetic Immunity
- EN61000-3-2 (IEC61000-3-2) - Power Line Harmonics
- EN61000-3-3 (IEC61000-3-3) - Power Line Flicker
- EN60950 (IEC950) - Product Safety

## Notice for France

DECLARATION D'INSTALLATION ET DE MISE EN EXPLOITATION d'un matériel de traitement de l'information (ATI), classé A en fonction des niveaux de perturbations radioélectriques émis, définis dans la norme européenne EN 55022 concernant la Compatibilité Electromagnétique.

## WEEE Recycling Notices

### English notice

**Disposal of waste equipment by users in private household in the European Union**



This symbol on the product or on its packaging indicates that this product must not be disposed of with your other household waste. Instead, it is your responsibility to dispose of your waste equipment by handing it over to a designated collection point for recycling of waste electrical and electronic equipment. The separate collection and recycling of your waste equipment at the time of disposal will help to conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For more information about where you can drop off your waste equipment for recycling, please contact your local city office, your household waste disposal service, or the shop where you purchased the product.

### Dutch notice

**Verwijdering van afgedankte apparatuur door priv-gebruikers in de Europese Unie**



Dit symbool op het product of de verpakking geeft aan dat dit product niet mag worden gedeponeerd bij het normale huishoudelijke afval. U bent zelf verantwoordelijk voor het inleveren van uw afgedankte apparatuur bij een inzamelingspunt voor het recyclen van oude elektrische en elektronische apparatuur. Door uw oude apparatuur apart aan te bieden en te recyclen, kunnen natuurlijke bronnen worden behouden en kan het materiaal worden hergebruikt op een manier waarmee de volksgezondheid en het milieu worden beschermd. Neem contact op met uw gemeente, het afvalinzamelingsbedrijf of de winkel waar u het product hebt gekocht voor meer informatie over inzamelingspunten waar u oude apparatuur kunt aanbieden voor recycling.

### Czechoslovakian notice

**Likvidace za?zen soukrommi domcmi uivateli v Evropsk unii**



Tento symbol na produktu nebo balen ozna?uje vrobek, kter nesm bt vyhozen spolu s ostatnm domcm odpadem. Povinnost uivatele je p?edat takto ozna?en odpad na p?edem ur?en sb?rn msto pro recyklaci elektrickch a elektronickch za?zen. Okamit t?d?n a recyklace odpadu pom?e uchovat p?rodn prost?ed a zajist takov zp?sob recyklace, kter ochrn zdrav a ivotn prost?ed ?lov?ka. Dal informace o monostech odevzdn odpadu k recyklaci zskte na p?slunm obecnm nebo m?stskm ?ad?, od firmy zabvajc se sb?rem a svozem odpadu nebo v obchod?, kde jste produkt zakoupili.

## Estonian notice

**Seadmete jtmete krvaldamine eramajapidamistes Euroopa Liidus**



See tootel vi selle pakendil olev smbol nitab, et knealust toodet ei tohi koos teiste majapidamisjtmetega krvaldada. Teie kohus on oma seadmete jtmed krvaldada, viies need elektri- ja elektroonikaseadmete jtmete ringlussevtmiseks selleks ettenhtud kogumispunkti. Seadmete jtmete eraldi kogumine ja ringlussevtmine krvaldamise ajal aitab kaitsta loodusvarasid ning tagada, et ringlussevtmine toimub viisil, mis kaitseb inimeste tervist ning keskkonda. Lisateabe saamiseks selle kohta, kuhu oma seadmete jtmed ringlussevtmiseks viia, vtke palun hendust oma kohaliku linnakantselei, majapidamisjtmete krvaldamise teenistuse vi kauplusega, kust Te toote ostsite.

## Finnish notice

**Laitteiden hvittminen kotitalouksissa Euroopan unionin alueella**



Jos tuotteessa tai sen pakkauksessa on tm merkki, tuotetta ei saa hvitt kotitalousjtteiden mukana. Tllin hvitettv laite on toimitettava shklaitteiden ja elektronisten laitteiden kierrtyspisteeseen. Hvitettvien laitteiden erillinen ksittely ja kierrtys auttavat sstmn luonnonvaroja ja varmistamaan, ett laite kierrtetn tavalla, joka est terveyshaitat ja suojelee luontoa. Listietoja paikoista, joihin hvitettvt laitteet voi toimittaa kierrtettvksi, saa ottamalla yhteytt jtehuoltoon tai liikkeeseen, josta tuote on ostettu.

## French notice

**limination des appareils mis au rebut par les mnages dans l'Union europenne**



Le symbole appos sur ce produit ou sur son emballage indique que ce produit ne doit pas tre jet avec les dchets mnagers ordinaires. Il est de votre responsabilit de mettre au rebut vos appareils en les dposant dans les centres de collecte publique dsigns pour le recyclage des quipements lectriques et lectroniques. La collecte et le recyclage de vos appareils mis au rebut indpendamment du reste des dchets contribue la prservation des ressources naturelles et garantit que ces appareils seront recycls dans le respect de la sant humaine et de l'environnement. Pour obtenir plus d'informations sur les centres de collecte et de recyclage des appareils mis au rebut, veuillez contacter les autorits locales de votre rgion, les services de collecte des ordures mnagres ou le magasin dans lequel vous avez achet ce produit.

## German notice

**Entsorgung von Altgerten aus privaten Haushalten in der EU**



Das Symbol auf dem Produkt oder seiner Verpackung weist darauf hin, dass das Produkt nicht ber den normalen Hausmll entsorgt werden darf. Benutzer sind verpflichtet, die Altgerte an einer Rcknahmestelle fr Elektro- und Elektronik-Altgerte abzugeben. Die getrennte Sammlung und ordnungsgeme Entsorgung Ihrer Altgerte trgt zur Erhaltung der natrlichen Ressourcen bei und garantiert eine Wiederverwertung, die die Gesundheit des Menschen und die Umwelt schtzt. Informationen dazu, wo Sie Rcknahmestellen fr Ihre Altgerte finden, erhalten Sie bei Ihrer Stadtverwaltung, den rtlichen Mllentsorgungsbetrieben oder im Geschft, in dem Sie das Gert erworben haben.

## Greek notice

**Απόρριψη άχρηστου εξοπλισμού από χρήστες σε ιδιωτικά νοικοκυριά στην Ευρωπαϊκή 'Ενωση**



Το σύμβολο αυτό στο προϊόν ή τη συσκευασία του υποδεικνύει ότι το συγκεκριμένο προϊόν δεν πρέπει να διατίθεται μαζί με τα άλλα οικιακά σας απορρίμματα. Αντίθετα, είναι δική σας ευθύνη να απορρίψετε τον άχρηστο εξοπλισμό σας παραδίδοντάς τον σε καθορισμένο σημείο συλλογής για την ανακύκλωση άχρηστου ηλεκτρικού και ηλεκτρονικού εξοπλισμού. Η ξεχωριστή συλλογή και ανακύκλωση του άχρηστου εξοπλισμού σας κατά την απόρριψη θα συμβάλει στη διατήρηση των φυσικών πόρων και θα διασφαλίσει ότι η ανακύκλωση γίνεται με τρόπο που προστατεύει την ανθρώπινη υγεία και το περιβάλλον. Για περισσότερες πληροφορίες σχετικά με το πού μπορείτε να παραδώσετε τον άχρηστο εξοπλισμό σας για ανακύκλωση, επικοινωνήστε με το αρμόδιο τοπικό γραφείο, την τοπική υπηρεσία διάθεσης οικιακών απορριμμάτων ή το κατάστημα όπου αγοράσατε το προϊόν.

## Hungarian notice

**Kszlkek magnhztartsban trtn? selejtezse az Eurpai Uni terletn**



A kszlken, illetve a kszlk csomagolsn lthat azonos szimblum annak jelzsre szolgl, hogy a kszlk a selejtezs sorn az egyb hztartsi hulladktl eltr? mdon kezelend?. A vsrl a hulladkk vlt kszlket kteles a kijellt gy?jt?helyre szlltani az elektromos s elektronikai kszlkek jrahasznostsa cljbl. A hulladkk vlt kszlkek selejtezskori begy?jtse s jrahasznostsa hozzjrul a termszeti er?forrsok meg?rzshez, valamint biztostja a selejtezett termkek krnyezetre s emberi egszsgre nzve biztonsgos feldolgozst. A begy?jts pontos helyr?l b?vebb tjkoztatst a lakhelye szerint illetkes nkormnyzattl, az illetkes szemteltakart vllalattl, illetve a termket elrust helyen kaphat.

## Italian notice

**Smaltimento delle apparecchiature da parte di privati nel territorio dellUnione Europea**



Questo simbolo presente sul prodotto o sulla sua confezione indica che il prodotto non pu essere smaltito insieme ai rifiuti domestici. responsabilit dell'utente smaltire le apparecchiature consegnandole presso un punto di raccolta designato al riciclo e allo smaltimento di apparecchiature elettriche ed elettroniche. La raccolta differenziata e il corretto riciclo delle apparecchiature da smaltire permette di proteggere la salute degli individui e l'ecosistema. Per ulteriori informazioni relative ai punti di raccolta delle apparecchiature, contattare l'ente locale per lo smaltimento dei rifiuti, oppure il negozio presso il quale stato acquistato il prodotto.

## Latvian notice

**Nolietotu iek?rtu izn?cin?anas noteikumi lietot?jiem Eiropas Savien?bas priv?taj?s m?jsaimniec?b?s**



?ds simbols uz izstr?d?juma vai uz t? iesai?ojuma nor?da, ka o izstr?d?jumu nedr?kst izmest kop? ar citiem sadz?ves atkritumiem. J?s atbildat par to, lai nolietot?s iek?rtas tiktu nodotas speci?li iek?rtotos punktos, kas paredz?ti izmantoto elektrisko un elektronisko iek?rtu sav?kanai otrreiz?jai p?rstr?dei. Atsevi?a nolietoto iek?rtu sav?kana un otrreiz?j? p?rstr?de pal?dz?s saglab?t dabas resursus un garant?s, ka ?s iek?rtas tiks otrreiz?ji p?rstr?d?tas t?d? veid?, lai pasarg?tu vidi un cilv?ku vesel?bu. Lai uzzin?tu, kur nolietot?s iek?rtas var izmest otrreiz?jai p?rstr?dei, j?v?ras savas dz?ves vietas pavald?b?, sadz?ves atkritumu sav?kanas dienest? vai veikal?, kur? izstr?d?jums tika nopirkts.

## Lithuanian notice

**Vartotoj? i priva?i? nam? ?ki? ?rangos atliek? alinimas Europos S?jungoje**



is simbolis ant gaminio arba jo pakuot?s rodo, kad io gaminio alinti kartu su kitomis nam? ?kio atliekomis negalima. alintinas ?rangos atliekas privalote pristatyti ? speciali? surinkimo viet? elektros ir elektronin?s ?rangos atliekoms perdirbti. Atskirai surenkamos ir perdirbamos alintinos ?rangos atliekos pad?s saugoti gamtinius iteklius ir utikrinti, kad jos bus perdirbtos tokiu b?du, kuris nekenkia moni? sveikatai ir aplinkai. Jeigu norite suinoti daugiau apie tai, kur galima pristatyti perdirbtinas ?rangos atliekas, kreipkit?s ? savo seni?nij?, nam? ?kio atliek? alinimo tarnyb? arba parduotuv?, kurioje ?sigijote gamin?.

## Polish notice

**Pozbywanie si? zu?ytego sprz?tu przez u?ytkownikw w prywatnych gospodarstwach domowych w Unii Europejskiej**



Ten symbol na produkcie lub jego opakowaniu oznacza, ?e produktu nie wolno wyrzuca? do zwyk?ych pojemnikw na ?mieci. Obowi?zkiem u?ytkownika jest przekazanie zu?ytego sprz?tu do wyznaczonego punktu zbirki w celu recyklingu odpadw powsta?ych ze sprz?tu elektrycznego i elektronicznego. Osobna zbirka oraz recykling zu?ytego sprz?tu pomog? w ochronie zasobw naturalnych i zapewni? ponowne wprowadzenie go do obiegu w sposb chroni?cy zdrowie cz?owieka i ?rodowisko. Aby uzyska? wi?cej informacji o tym, gdzie mo?na przekaza? zu?yty sprz?t do recyklingu, nale?y si? skontaktowa? z urz?dem miasta, zak?adem gospodarki odpadami lub sklepem, w ktrym zakupiono produkt.

## Portuguese notice

**Descarte de Lixo Eltrico na Comunidade Europia**



Este smbolo encontrado no produto ou na embalagem indica que o produto no deve ser descartado no lixo domstico comum. responsabilidade do cliente descartar o material usado (lixo eltrico), encaminhando-o para um ponto de coleta para reciclagem. A coleta e a reciclagem seletivas desse tipo de lixo ajudaro a conservar as reservas naturais; sendo assim, a reciclagem ser feita de uma forma segura, protegendo o ambiente e a sade das pessoas. Para obter mais informaes sobre locais que reciclam esse tipo de material, entre em contato com o escritrio da HP em sua cidade, com o servio de coleta de lixo ou com a loja em que o produto foi adquirido.

## Slovakian notice

**Likvidcia vyradench zariaden v domcnostiach v Eurpskej nii**



Symbol na vrobku alebo jeho balen ozna?uje, e dan vrobok sa nesmie likvidova? s domovm odpadom. Povinnos?ou spotrebite?a je odovzda? vyraden zariadenie v zbernom mieste, ktor je ur?en na recyklciu vyradench elektrickch a elektronickch zariaden. Separovan zber a recyklcia vyradench zariaden prispieva k ochrane prrodnch zdrojov a zabezpe?uje, e recyklcia sa vykonva spsobom chrniacim ?udsk zdravie a ivotn prostredie. Informcie o zbernch miestach na recyklciu vyradench zariaden vm poskytne miestne zastupite?stvo, spolo?nos? zabezpe?ujca odvoz domovho odpadu alebo obchod, v ktorom ste si vrobok zakpili.

## Slovenian notice

**Odstranjevanje odsluene opreme uporabnikov v zasebnih gospodinjstvih v Evropski uniji**



Ta znak na izdelku ali njegovi embalai pomeni, da izdelka ne smete odvre?i med gospodinjske odpadke. Nasprotno, odslueno opremo morate predati na zbirali?e, poobla?eno za recikliranje odsluene elektri?ne in elektronske opreme. Lo?eno zbiranje in recikliranje odsluene opreme prispeva k ohranjanju naravnih virov in zagotavlja recikliranje te opreme na zdravju in okolju nekodljiv na?in. Za podrobneje informacije o tem, kam lahko odpeljete odslueno opremo na recikliranje, se obrnite na pristojni organ, komunalno slubo ali trgovino, kjer ste izdelek kupili.

## Spanish notice

**Eliminacin de residuos de equipos elctricos y electrnicos por parte de usuarios particulares en la Unin Europea**



Este smbolo en el producto o en su envase indica que no debe eliminarse junto con los desperdicios generales de la casa. Es responsabilidad del usuario eliminar los residuos de este tipo depositndolos en un "punto limpio" para el reciclado de residuos elctricos y electrnicos. La recogida y el reciclado selectivos de los residuos de aparatos elctricos en el momento de su eliminacin contribuir a conservar los recursos naturales y a garantizar el reciclado de estos residuos de forma que se proteja el medio ambiente y la salud. Para obtener ms informacin sobre los puntos de recogida de residuos elctricos y electrnicos para reciclado, pngase en contacto con su ayuntamiento, con el servicio de eliminacin de residuos domsticos o con el establecimiento en el que adquiri el producto.

## Swedish notice

**Bortskaffande av avfallsprodukter frn anvndare i privathushll inom Europeiska Unionen**



Om den hr symbolen visas p produkten eller frpackningen betyder det att produkten inte fr slngas p samma stlle som hushllssopor. I stllet r det ditt ansvar att bortskaffa avfallet genom att verlmna det till ett uppsamlingsstlle avsett fr tervinning av avfall frn elektriska och elektroniska produkter. Separat insamling och tervinning av avfallet hjlper till att spara p vra naturresurser och gr att avfallet tervinns p ett stt som skyddar mnniskors hlsa och miljn. Kontakta ditt lokala kommunkontor, din nrmsta tervinningsstation fr hushllsavfall eller affren dr du kpte produkten fr att f mer information om var du kan lmna ditt avfall fr tervinning.

# Germany noise declaration

Schalldruckpegel Lp = 70 dB(A)

Am Arbeitsplatz (operator position)

Normaler Betrieb (normal operation)

Nach ISO 7779:1999 (Typprüfung)

## Japanese notice

ご使用になっている装置にVCCIマークが付いていましたら、次の説明文をお読み下さい。

この装置は、情報処理装置等電波障害自主規制協議会（VCCI）の基準に基づくクラスB情報技術装置です。この装置は、家庭環境で使用することを目的としていますが、この装置がラジオやテレビジョン受信機に近接して使用されると、受信障害を引き起こすことがあります。
取扱説明書に従って正しい取り扱いをして下さい。

VCCIマークが付いていない場合には、次の点にご注意下さい。

この装置は、情報処理装置等電波障害自主規制協議会（VCCI）の基準に基づくクラスA情報技術装置です　この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

## Harmonics conformance (Japan)

高調波ガイドライン適合品

## Taiwanese notice

警告使用者:
這是甲類的資訊產品，在居住的環境中使用時，可能會造成射頻干擾，在這種情況下，使用者會被要求採取某些適當的對策。

## Japanese power cord notice

製品には、同梱された電源コードをお使い下さい。
同梱された電源コードは、他の製品では使用出来ません。

## Country-specific certifications

HP tests electronic products for compliance with country-specific regulatory requirements, as an individual item or as part of an assembly. The product label (see Figure 74) specifies the regulations with which the product complies.

**NOTE:**

Elements without an individual product certification label are qualified as part of the next higher assembly (for example, enclosure, rack, or tower).




CXO8157A

**Figure 74 Typical enclosure certification label**

NOTE:

The certification symbols on the label depend upon the certification level. For example, the FCC Class A certification symbol is not the same as the FCC Class B certification symbol.

# About countryspecific regulations

HP tests electronic products for compliance with countryspecific regulatory requirements, as an individual item or as part of an assembly. The product label specifies the regulations with which the product complies.

NOTE:

Elements without an individual product certification label are qualified as part of the *next higher* assembly (for example, enclosure, rack, or tower). The certification symbols on the label depend upon the certification level. For example, the FCC Class A certification symbol is not the same as the FCC Class B certification symbol.

# Japanese cord caution statement

製品には、同梱された電源コードをお使い下さい。
同梱された電源コードは、他の製品では使用出来ません。

translation
Please use the attached power cord.
The attached power cord is not allowed to use with other product.

**Figure 75 Japanese cord caution**

# Fibre Channel drive enclosure specifications

This appendix defines the physical, environmental, and power specifications of the Fibre Channel disk drive enclosure and elements.

## Physical specifications

This section describes the physical specifications of the drive enclosure and elements.

△ CAUTION:

An assembled enclosure (all elements installed) weighs more than 65 lbs (29.5 kg) and requires a minimum of two individuals to move.

Table 26 defines the dimensions and weights of the enclosure.

**Table 26 Drive enclosure physical specifications**

| | Empty | Installed | Shipping | |
|---|---|---|---|---|
| | | | Carton | Carton & pallet |
| Height | 131 mm (5.16 in) | 131 mm (5.16 in) | 641 mm (25.25 in) | 768 mm (30.25 in) |
| Width | 505 mm (19.875 in) | 505 mm (19.875 in) | 318 mm (12.5 in) | 610 mm (24 in) |
| Depth | 448 mm (17.625 in) | 448 mm (17.625 in) | 597 mm (23.5 in) | 1016 mm (40 in) |
| Weight | 10.9 kg (24 lb) | 30.9 kg (68 lb) | 43.6 kg (96 lb) | 49 kg (108 lb) |

NOTE:

Metric dimensions are expressed in whole numbers. For example, 10.795 cm is expressed as 108 mm. Millimeter dimensions are always expressed in whole numbers.

Table 27defines the dimensions of the elements (that is, EMU, blowers, I/O module, drives, and power supply).

**Table 27 Drive enclosure elements physical specifications**

| Specification | Installed | Shipping Carton |
|---|---|---|
| **Environmental Monitoring Unit (EMU)** | | |
| Height | 114 mm (4.5 in) | 210 mm (8.25 in) |
| Width | 241 mm (9.5 in) | 330 mm (13.5 in) |
| Depth | 35 mm (1.375 in) | 108 mm (4.25 in) |
| Weight | 0.6 kg (1.3 lb) | 0.91 lb (2.0 lb) |
| Blower | | |
| Height | 140 mm (5.5 in) | 191 mm (7.5 in) |
| Width | 159 mm (6.25 in) | 203 mm (8.0 in) |
| Depth | 83 mm (3.25 in) | 229 mm (9.0 in) |
| Weight | 0.45 kg (1.0 lb) | 0.91 kg (2.0 lb) |
| **I/O Module** | | |
| Height | 114 mm (4.5 in) | 210 mm (8.25 in) |
| Width | 41 mm (1.625 in) | 108 mm (4.25 in) |
| Depth | 241 mm (9.5 in) | 330 mm (13.0 in) |
| Weight | 0.59 kg (1.3 lb) | 0.77 kg (1.7 lb) |
| Disk Drive | | |
| Height | 114 mm (4.5 in) | 216 mm (8.5 in) |
| Width | 26 mm (1.025 in) | 114 mm (4.5 in) |
| Depth | 241 mm (9.5 in) | 330 mm (13.0 in) |
| Weight | 0.59 kg (1.3 lb) | 1.0 kg (2.3 lb) |
| **Power Supply** (without blower) | | |
| Heigt | 114 mm (4.5 in) | 286 mm (11.25 in) |
| Width | 159 mm (6.25 in) | 330 mm (13.0 in) |
| Depth | 241 mm (9.5 in) | 419 mm (16.5 in) |
| Weight | 1.82 kg (4.0 lb) | 3.86 kg (8.5 lb) |

**NOTE:**

Metric dimensions are expressed in whole numbers. For example, 10.795 cm is expressed as 108 mm. Millimeter dimensions are always expressed in whole numbers.

## Environmental specifications

To ensure optimum product operation you must maintain the operational environmental specifications listed in Table 28. The ambient temperature, that is the enclosure air intake or room temperature, is especially critical.

**Table 28 Environmental operating specifications**

| |
|---|
| **Ambient temperature** : +10 °C to +35 °C (+50 °F to +95 °F) with an average rate of change of 1 °C/hour maximum and a step change of 3 °C or less. Maintaining the optimum ambient temperature within the specified range ensures that the internal operating temperatures support the drive manufacturer's MTBF specifications. |
| **Relative humidity:** 40% to 60% (noncondensing) with a step change of 10% or less (noncondensing) |
| **Air quality:** Not to exceed a maximum of 500,000 particles, 0.5 micron or larger, per cubic foot of air. |
| **Heat dissipation:** 1600 BTUs per hour |

When shipping, or placing this product in short term storage, HP recommends maintaining the environmental conditions listed in Table 29.

**Table 29 Environmental shipping or short-term storage specifications**

| |
|---|
| **Ambient temperature** : –40 °C to +66 °C (–40 °F to +151 °F) |
| **Relative humidity:** 10% to 80% noncondensing |
| **Altitude:** below 15,240 m (50,000 ft) |

## Power specifications

The input voltage to the drive enclosure power supplies is a function of the country-specific input voltage to Enterprise storage system rack power distribution units (PDUs). Table 30 defines the AC input power available to the drive enclosure power supplies.

△ CAUTION:

The AC power distribution within a rack ensures a balanced to each PDA and reduces the possibility of an overload condition. Changing the cabling to or from a PDM could cause an overload condition.

**Table 30 Enterprise storage system AC input line voltages**

| Specification | Minimal | Nominal | Maximum |
|---|---|---|---|
| | 60 Hz Service | | |
| AC Line Voltage | 57 Hz | 60 Hz | 63 Hz |
| AC Line Voltage—Japan | 180 VAC | 202 VAC | 220 VAC |
| AC Line Voltage–North America | 180 VAC | 208 VAC | 220 VAC |
| AC Line Voltage–Europe | 208 VAC | 240 VAC | 254 VAC |
| | 50 Hz Service | | |
| AC Line Frequency | 47 Hz | 50 Hz | 53 Hz |
| AC Line Voltage–Japan | 180 VAC | 202 VAC | 220 VAC |
| AC Line Voltage–North America | 190 VAC | 220 VAC | 235 VAC |
| AC Line Voltage–North America | 200 VAC | 230 VAC | 244 VAC |
| AC Line Voltage–Europe | 208 VAC | 240 VAC | 254 VAC |

Table 31 defines the AC input current and wattage to the drive encloure power supplies.

**Table 31 AC input current and wattage**

| Nominal | | Maximum | | |
|---|---|---|---|---|
| Input Voltage | Amps | Watts | Amps | Watts |
| 60–Hz Input | | | | |
| 100 VAC–JBOD | 4.35 | 436 | 6.41 | 641 |
| 208 VAC–North America | 2.03 | 419 | 2.94 | 609 |
| 50–Hz Input | | | | |
| 120 VAC–JBOD | 3.59 | 419 | 5.27 | 633 |
| 220 VAC–North America | 1.92 | 418 | 2.78 | 608 |
| 230 VAC–North America | 1.92 | 418 | 2.78 | 608 |
| 240 VAC–Europe | 1.76 | 416 | 2.55 | 607 |

Table 32 and Table 33 define the output voltage and current specifications of the power supply

**Table 32 Output voltage and current specifications**

| | | Range | |
|---|---|---|---|
| Specification | Minimum | Nominal | Maximum |
| +5.1 VDC | | | |
| Initial VoltageSteady state current | +5.13 VDC1.0 A | +5.18 VDCN/A | +5.23 VDC26.0 A |
| +12.2 VDC (Disk Drive Voltage) | | | |
| Initial VoltageSteady state current | +12.13 VDC1.0 A | +12.25 VDCN/A | +12.37 VDC26.0 A |
| +12.5 VDC (Disk Drive Voltage) | | | |
| Initial VoltageSteady state current | +12.25 VDC0.0 0A | +12.50 VDCN/A | +12.75 VDC2.0 A |

**Table 33 Dual power supply configuration power specifications**

| Voltage | Current (A) | Power (W) |
|---|---|---|
| Maximum continuous current | | |
| +5.1 VDC (with a minimum +12.2 VDC load of 0A) +12.2 VDC (with a minimum +5 VDC load of 4A) +12.5 VDC | 26.0 A 28.0 A 2.0 A | 132 W342.0 W25.0 W |
| **Total** | | 499.0 W |
| Maximum peak current (simultaneous seek activity) | | |
| +5.1 VDC +12.2 VDC +12.5 VDC | 26.0 A 43.0 A 2.0 A | 132.0 W 524.0 W 25.0 W |
| **Total** | | 681.0 W |

# Fibre Channel switch specifications

The Fibre Channel Switch requires a clean, dry environment for normal operation. Table 34 lists the specifications for the Fibre Channel Switch.

**Table 34 Fibre Channel switch specifications**

| Category | Measurement |
|---|---|
| Weight | approximately 7.5 lbs. |
| Dimensions | 8.50 x 1.57 x 16.00 in (W x H x D)The switch with extender is 21.66 in D |
| Operating Temperature | 0 °C to 40 °C for normal operation (ambient air temperature) |
| Storage Temperature | -40 °C to 80 °C noncondensing |
| Power | 50 or 60 Hz 100–250 VAC 0.5–0.3 A |

# Controller specifications

This section defines the physical, power, and environmental specifications of the Controller enclosure.

## Physical specifications

??? defines the dimensions of the controller and replaceable units.

**Table 35 Controller enclosure physical specifications**

| Specification | Installed | Shipping |
|---|---|---|
| Height | 62 mm (2.45 in) | 267 mm (10.5 in) |
| Width | 502 mm (19.56 in) | 762 mm (30 in) |
| Depth | 444 mm (17.49 in) | 762 mm (30 in) |
| Weight | 10.4 kg (23 lb) | 12.7 kg (28 lb) |

**NOTE:**

Metric dimensions are expressed in whole numbers. For example, 10.795 cm is expressed as 108 mm.

## Power specifications

Table 36 and Table 37 define the HSV110 Controller power supply input power requirements and output power specifications.

**Table 36 Controller power supply AC power requirements**

| AC input voltage | | | Frequency | | |
|---|---|---|---|---|---|
| Minimum | Nominal | Maximum | Minimum | Nominal | Maximum |
| 180 VAC | 202 VAC | 220 VAC | 47 Hz | 50 Hz | 53 Hz |
| | 208 VAC | | 57 Hz | 60 Hz | 63 Hz |
| 208 VAC | 240 VAC | 254 VAC | | | |

Table 37 defines the AC input current and wattage to the controller power supplies.

**Table 37 AC input current and wattage**

| Nominal | | Maximum | | |
|---|---|---|---|---|
| Input voltage | Amps | Watts | Amps | Watts |
| 60-Hz Input | | | | |
| 100 VAC–JBOD | 4.35 | 436 | 6.41 | 641 |
| 208 VAC–North America | 2.03 | 419 | 2.94 | 609 |
| 50-Hz Input | | | | |
| 120 VAC–JBOD | 3.59 | 419 | 5.27 | 633 |
| 220 VAC–North America | 1.92 | 418 | 2.78 | 608 |
| 230 VAC–North America | 1.92 | 418 | 2.78 | 608 |
| 240 VAC–Europe | 1.76 | 416 | 2.55 | 607 |

**Table 38 Controlle power supply output specifications**

| Voltage Specification | Minimum | Nominal | Maximum |
|---|---|---|---|
| +3.3 VDC | | | |
| Output VoltageSteady state current Power | 3.23 VDC | 3.30 VDC | 3.36 VDC 18 A[1] 59.4W |
| +5.0 VDC | | | |
| Output Voltage Steady state current Power | 4.90 VDC | 5.00 VDC | 5.10 VDC 4 A 20.0W |
| +12.0 VDC | | | |
| Output Voltage Steady state current Power | 11.4 VDC | 12.0 VDC | 12.6 VDC 2 A 4.0W |
| Total Current Total Power | | | 24 A 65.4W |
| 1 | | | |

[1]+3.3 VDC steady state current requires a minimum 5.0-V load of 1 A.

## Environmental specifications

There are no controller environmental specifications. See the the section called "Rack" environmental specifications for this information in the next section.

# Rack

## Physical specifications

⚠ WARNING!

The weight of the drive enclosure with the elements installed always requires at least two individuals to move. HP recommends using a fork lift or a hand truck to move an enclosure in the shipping container.

Table 39 through Table 44 define the dimensions and weights of the 9000-Series and 10000-Series Enterprise Virtual Array racks.

**Table 39 9000-Series Enterprise 42U Rack Physical Dimensions**

| Configuration | Height in / mm | Width in / mm | Depth in / mm | Max Wt lbs / kg |
|---|---|---|---|---|
| Enterprise 2C6D | 78.75 / 2000.0 | 23.7 / 602 | 35.8 / 909 | 918 / 416 |
| Enterprise 2C12D | 78.75 / 2000.0 | 23.7 / 602 | 35.8 / 909 | 1350 / 612 |
| Enterprise 0C6D | 78.75 / 2000.0 | 23.7 / 602 | 35.8 / 909 | 818 / 371 |
| Enterprise 0C12D | 78.75 / 2000.0 | 23.7 / 602 | 35.8 / 909 | 1250 / 567 |

### Table 40 9000-Series Enterprise 42U Rack Shipping Dimensions

| Configuration | Height in / mm | Width in / mm | Depth in / mm | Max Wt (packaging) lbs / kg |
|---|---|---|---|---|
| Enterprise 2C6D | 85.38 / 2169 | 36.0 / 914 | 48.0 / 1220 | 1111 / 504 |
| Enterprise 2C12D | 85.38 / 2169 | 36.0 / 914 | 48.0 / 1220 | 1543 / 700 |
| Enterprise 0C6D | 85.38 / 2169 | 36.0 / 914 | 48.0 / 1220 | 1011 / 459 |
| Enterprise 0C12D | 85.38 / 2169 | 36.0 / 914 | 48.0 / 1220 | 1443 / 654 |

### Table 41 9000-Series Enterprise 41U Rack Physical Dimensions

| Configuration | Height in / mm | Width in / mm | Depth in / mm | Max Wt lbs / kg |
|---|---|---|---|---|
| Enterprise 2C6D | 78.75 / 2000.0 | 23.7 / 602 | 39.1 / 993 | 917 / 416 |
| Enterprise 2C12D | 78.75 / 2000.0 | 23.7 / 602 | 39.1 / 993 | 1349 / 612 |
| Enterprise 0C6D | 78.75 / 2000.0 | 23.7 / 602 | 39.1 / 993 | 817 / 371 |
| Enterprise 0C12D | 78.75 / 2000.0 | 23.7 / 602 | 39.1 / 993 | 1249 / 567 |

### Table 42 9000-Series Enterprise 41U Rack Shipping Dimensions

| Configuration | Height in / mm | Width in / mm | Depth in / mm | Max Wt (packaging) lbs / kg |
|---|---|---|---|---|
| Enterprise 2C6D | 85.38 / 2169 | 36.0 / 914 | 48.0 / 1220 | 1110 / 503 |
| Enterprise 2C12D | 85.38 / 2169 | 36.0 / 914 | 48.0 / 1220 | 1542 / 699 |
| Enterprise 0C6D | 85.38 / 2169 | 36.0 / 914 | 48.0 / 1220 | 1010 / 458 |
| Enterprise 0C12D | 85.38 / 2169 | 36.0 / 914 | 48.0 / 1220 | 1442 / 654 |

### Table 43 10000-Series Enterprise 42U Rack Physical Dimensions

| Configuration | Height in / mm | Width in / mm | Depth in / mm | Max Wt lbs / kg |
|---|---|---|---|---|
| Enterprise 2C6D | 78.75 / 2000.0 | 23.7 / 600 | 39.3 / 1000 | 918 / 416 |
| Enterprise 2C12D | 78.75 / 2000.0 | 23.7 / 600 | 39.3 / 1000 | 1350 / 612 |
| Enterprise 0C6D | 78.75 / 2000.0 | 23.7 / 600 | 39.3 / 1000 | 818 / 371 |
| Enterprise 0C12D | 78.75 / 2000.0 | 23.7 / 600 | 39.3 / 1000 | 1250 / 567 |

### Table 44 10000-Series Enterprise 42U Rack Shipping Dimensions

| Configurations | Height in / mm | Width in / mm | Depth in / mm | Max Wt (packaging) lbs / kg |
|---|---|---|---|---|
| Enterprise 2C6D | 86.22 / 2190 | 32.0 / 813 | 48.0 / 1220 | 1111 / 504 |
| Enterprise 2C12D | 86.22 / 2190 | 32.0 / 813 | 48.0 / 1220 | 1543 / 700 |
| Enterprise 0C6D | 86.22 / 2190 | 32.0 / 813 | 48.0 / 1220 | 1011 / 459 |
| Enterprise 0C12D | 86.22 / 2190 | 32.0 / 813 | 48.0 / 1220 | 1443 / 654 |

## Environmental specifications

To ensure optimum product operation, you must maintain the operational environmental specifications listed in Table 45. The ambient temperature (the enclosure air intake or room temperature) is especially critical.

**Table 45 Environmental operating specifications**

| |
|---|
| **Ambient temperature**: +10 °C to +35 °C (+50 °F to +95 °F) with an average rate of change of 1 °C/hour maximum and a step change of 3 °C or less. Maintaining the optimum ambient temperature within the specified range ensures that the internal operating temperatures support the drive manufacturer's MTBF specifications. |
| **Relative humidity:** 40% to 60% (noncondensing) with a step change of 10% or less (noncondensing). |
| **Air quality:** Not to exceed a maximum of 500,000 particles, 0.5 micron or larger, per cubic foot of air. |
| **Heat dissipation:** 12,708 BTUs per hour. |

When shipping, or placing this product in short term storage, HP recommends maintaining the environmental conditions listed in Table 46.

**Table 46 Environmental shipping or short term storage specifications**

| |
|---|
| **Ambient temperature**: –40 °C to +66 °C (–40 °F to +151 °F) |
| **Relative humidity:** 10% to 80% (noncondensing) |
| **Altitude:** below 15,240 m (50,000 ft) |

## Power specifications

Table 47 defines the AC power specifications for the Enterprise Virtual Array PDUs, PDMs, drive enclosure power supplies, and controller enclosure power supplies.

**Table 47 Enterprise Virtual Array AC power specifications**

| Nominal input voltage | Specifications |
|---|---|
| 60-Hz Service | |
| 202 VAC Voltage Range Power Receptacle | **Japan** 180-220 VAC, 57-63Hz, 32 A, Single Phase 3-wire, 2-pole, IEC 309 |
| 208 VAC Voltage Range Power Receptacle | **North America** 180-220 VAC, 57-63Hz, 32 A, Single Phase 3-wire, 2-pole, NEMA L6-30 |
| 240 VAC Voltage Range Power Receptacle | **Europe** 208-254 VAC, 57-63 Hz, 32 A, Single Phase 3-wire, 2-pole, IEC 309 |
| 50-Hz Service | |
| 202 VAC Voltage Range Power Receptacle | **Japan** 180-220 VAC, 47-63Hz, 32 A, Single Phase 3-wire, 2-pole, IEC 309 |
| 220 VAC Voltage Range Power Receptacle | **North America** 190-235 VAC, 47-63Hz, 32 A, Single Phase 3-wire, 2-pole, NEMA L6-30 |
| 230 VAC Voltage Range Power Receptacle | **North America** 200-244 VAC, 47-63Hz, 32 A, Single Phase 3-wire, 2-pole, NEMA L6-30 |
| 240 VAC Voltage Range Power Receptacle | **Europe** 208-254 VAC, 57-63 Hz, 32 A, Single Phase 3-wire, 2-pole, IEC 309 |

The power consumption of an Enterprise Virtual Array is 3,724 W.

# B EMU generated condition reports

This section provides a description of the EMU generated condition reports that contain the following information:

- Element type (*et*), a hexadecimal number in the range *01* through *FF*.
- Element number (*en*), a decimal number in the range *00* through *99* that defines a probable cause of the problem.
- Error code (*ec*), a decimal number in the range *00* through *99*.
- The recommended corrective action.

**NOTE:**

The conventions used to differentiate between the elements of the condition report are:

- The element type has a period after each character.
- The element number has a period after the second character.
- The error code has no periods.

The EMU can send error messages to the controller for transmission to the Command View EVA graphical user interface (GUI). The messages displayed are specific to Command View EVA and are not within the scope of this publication.

This appendix explains the condition report format, correcting problems, and how to identify element types. The error codes are arranged in element type sequence (that is, *0.1., 0.2., 0.3., etc*).

## Condition report format

When the EMU alphanumeric display is Er, there are additional displays that identify the element type, the specific element, and the error code, which defines the possible cause of the problem.

- The first-level display defines the type of element affected with two alphanumeric characters separated by periods such as *0.1., 0.2., 1.3., F.F.*, and so forth. A disk drive problem would display an element type number of *0.1*.
- The second-level display defines the element affected with a two-digit, decimal number followed by a period. For example, when a bay 6 drive error occurs, the element number display is *06.*; a display of *14.* indicates a bay 14 problem.
- The third-level display defines a specific problem, the error code with a two-digit, decimal number. For example, should the problem be either the installation of an incorrectly configured drive or one that cannot operate at the loop link rate, the display is *01*.

## Correcting errors

Correcting an error may require you to perform a specific set of actions. In some cases, the only available corrective action is to replace the element.

??? lists the element type codes assigned to the drive enclosure elements. Elements that do not have an active condition report are shaded.

**Table 48 Assigned element type codes**

| Code | Element |
|---|---|
| 0.1. | Disk Drives (see Drive Conditions) |
| 0.2. | Power Supplies (see Figure 46) |
| 0.3. | Blowers (see Figure 46 ) |
| 0.4. | Temperature Sensors (see Table 49) |
| 0.6 | Audible Alarm [1] |
| 0.7. | EMU |
| 0.C. | Controller OCP LCD[1] |
| 0.F. | Transceivers (see Figure 79) |
| 1.0. | Language[1] |
| 1.1. | Communication Port[1] |
| 1.2. | Voltage Sensors (see Table 50) |
| 1. | Current Sensors (see Table 50) |
| 8.0 | Drive Enclosure[1] |
| 8.2. | Drive Enclosure Backplane |
| 8.7. | I/O Modules (see I/O module B and I/O module A) |
| 1 | |

[1]A shaded element does not generate a condition report. However, for any error, you should record the error code. Then, implement the recommended corrective action.

## Drive conditions

The format of a disk drive condition report is *0.1.en.ec*, where:

- *0.1.* is the disk drive element type number
- *en.* is the two-character disk drive element
- *ec* is the error code

A direct correlation exists between the disk drive element number and the bay number. However, no direct correlation exists between the disk drive bay number and the device FC-AL physical address. The FC-AL physical address is assigned by negotiation during system initialization.

The following sections define the disk drive error codes.

### 0.1.en.01 CRITICAL condition—Drive configuration or drive link rate

As each drive spins up and comes on-line,the EMU determines if the drive is Fibre Channel compatible and can operate at the link rate (1 Gbps or 2 Gbps) established by the I/O module. If either of these conditions are not met, the EMU issues the condition report *0.1.en.01*.

The corrective actions for these conditions are:

- When the drive is not Fibre Channel-compatible you must install a Fibre Channel compatible drive or a drive blank.
- When the drive is Fibre Channel-compatible, the EMU compares the drive link rate with the I/O module link rate, the loop link rate.

If the EMU cannot determine the drive link rate, the EMU activates the drive bypass function for one minute. During this time the EMU continually checks the drive to determine the link rate.

- If the EMU determines the drive cannot operate at the Fibre Channel link rate set by the I/O module, the drive bypass function ends and the drive is placed on the loop. This does not generate a condition report.
- The EMU issues the condition report *0.1.en.01* when the drive link rate is incompatible with Fibre Channel link rate.
- When the EMU cannot determine the drive link rate during the one-minute drive bypass time, the EMU places the drive on the loop. This process allows the drive to negotiate for an address.
  - If negotiation indicates the link rates are compatible, the EMU rechecks the drive link rate to verify compatibility.
  - If negotiation indicates the link rates are incompatible, an error condition exists and drive loop data transfers stop.

This condition report remains active until the problem is corrected. The problem affects disk drive en. Therefore, correction to prevent the possible failure of other elements is not required.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Replace the defective drive with:
   - A Fibre Channel-compatible drive.
   - A Fibre Channel drive capable of operating at a link rate supported by I/O modules and transceivers.
3. Observe the EMU to ensure the error is corrected.
4. If unable to correct the problem, contact your authorized service representative.

## 0.1.en.02 INFORMATION condition—Drive missing

The drive is improperly installed or missing. Either option could affect the enclosure air flow and cause an overtemperature condition for another element.

- This error remains active for one minute, or until the problem is corrected, whichever *occurs first*.
- Immediate correction is not required. However, correction cannot be delayed indefinitely.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Remove and install the drive to ensure that it is properly installed.
3. Observe the EMU to ensure the error is corrected.
4. If removing and installing the drive did not correct the problem, install a replacement drive or a drive blank.
5. Observe the EMU to ensue the error is corrected.
6. If unable to correct the problem, contact your authorized service representative.

## 0.1.en.03 INFORMATION condition—Drive software lock active

Some enclosures have a software-activated lock that prevents physically removing a drive while this feature is active. This feature can be activated even when an enclosure does not have a physical lock. Removing a drive when this feature is active generates a condition report. This error remains active for 15 seconds.

No action is required to correct this condition.

### 0.1.en.04 CRITICAL condition—Loop A drive link Rate incorrect

The drive is capable of operating at the loop link rate, but is running at a different rate. For example, the drive is operating at 1 Gbps, and the loop is operating at 2 Gbps. Only when the drive is operating at the Fibre Channel link rate established by the I/O module can this drive transfer data.

This error remains active until the problem is corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Remove and replace the drive in the enclosure.
3. Observe the drive status LEDs to ensure the drive is operational.
4. Observe the EMU to ensure the error is corrected.
5. If removing and replacing the drive did not correct the problem, replace the drive.
6. Observe the drive status LEDs to ensure the drive is operational.
7. Observe the EMU to ensure the error is corrected.
8. If unable to correct the problem, contact your authorized service representative.

### 0.1.en.05 CRITICAL condition—Loop B drive link rate incorrect

The drive is capable of operating at the loop link rate but is running at a different rate. For example, the drive is operating at 1 Gbps, and the loop is operating at 2 Gbps. Only when the drive is operating at the Fibre Channel link rate established by the I/O module can this drive transfer data.

This error remains active until the problem is corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Remove and replace the drive in the enclosure.
3. Observe the drive status LEDs to ensure the drive is operational.
4. Observe the EMU to ensure the error is corrected.
5. If removing and replacing the drive did not correct the problem, replace the drive.
6. Observe the drive status LEDs to ensure the drive is operational.
7. Observe the EMU to ensure the error is corrected.
8. If unable to correct the problem, contact your authorized service representative.

## Power supply conditions

The format of a power supply condition report is *0.2.en.ec*, where:

- *0.2.* is the power supply element type number
- *en.* is the two-character power supply element number
- *ec* is the error code

Figure 76 shows the location of power supply 1 and power supply 2.

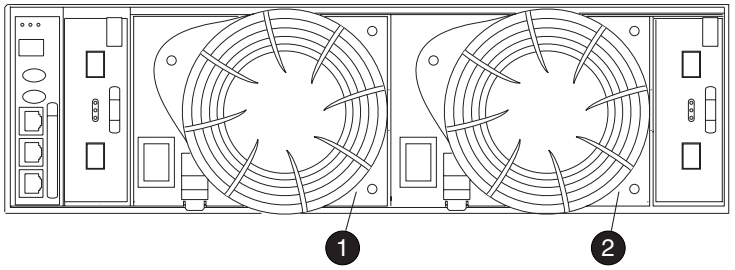



**Figure 76 Power supply element numbering**

The following sections define the power supply condition reports.

## 0.2.en.01 NONCRITICAL Condition—Power Supply AC Input Missing

The loss of the AC input to a power supply makes the remaining power supply a single point of failure.

This condition report remains active until AC power is applied to the power supply.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Ensure that there is AC power to the rack PDU, and from the PDU to the PDMs and that the PDU and PDM circuit breakers are not reset.

   If there is no AC power to the PDU, contact building facilities management.

   Verify that the power supply AC power cord is properly connected.
3. If AC is present, and the rack power distribution circuitry is functioning properly, the power supply LED should be on.
4. Observe the EMU to ensure the error is corrected.
5. Contact your authorized service representative.

## 0.2.en.02 UNRECOVERABLE Condition—Power Supply Missing

This condition report indicates a power supply is not installed or installed incorrectly. Both of these conditions affect air flow within the enclosure and can cause an overtemperature condition. Enclosure shutdown is imminent.

The operational power supply will automatically shut down after seven minutes, thereby disabling the enclosure. This condition report remains active until either the problem is corrected, or the operational power supply shuts down, whichever occurs first.

To correct this problem, record all six characters of the condition report, then contact your authorized service representative.

△ **CAUTION:**

Removing power from an enclosure may cause the loss or corruption of data. To avoid this condition, shut down the system using Command View EVA. An automatic shutdown and possible data corruption may result if the power supply is removed before a replacement is available.

## 0.2.en.03 CRITICAL Condition—Power Supply Load Unbalanced

This condition report indicates that a component within a power supply may have failed. This can make the remaining power supply a single point of failure.

This condition report remains active until corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Ensure that the blower on the power supply is functioning properly. If not, correct the blower condition and wait one minute.
3. Contact your authorized service representative.

## Blower conditions

The format of a blower condition report is *0.3.en.ec*, where:

- *0.3.* is the blower element type number
- *en.* is the two-character blower element number
- *ec* is the error code

As shown in Figure 77, blower 1 is in location 1 and blower 2 is in location 2.

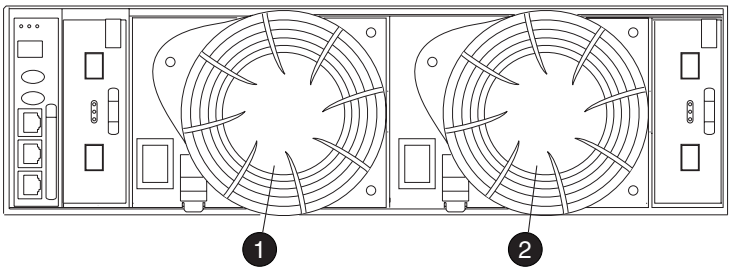



**Figure 77 Blower element numbering**

△ CAUTION:

A single blower operating at high speed can provide sufficient air flow to cool an enclosure and the elements for up to 100 hours. However, operating an enclosure at temperatures approaching an overheating threshold can damage elements and may reduce the MTBF of a specific element. Immediate replacement of the defective blower is required.

The following sections define the power supply condition reports.

### 0.3.en.01 NONCRITICAL condition—Blower speed

A blower is operating at a speed outside of the EMU specified range, possibly because of a bearing problem. This can affect enclosure cooling and cause an element to fail. This condition report remains active until the problem is corrected.

This error does not normally require immediate correction. However, an error of this type could contribute to an element overheating.

HP recommends replacing the blower as soon as possible.

To correct this problem, record all six characters of the condition report, then contact your HP authorized service representative.

### 0.3.en.02 CRTICAL condition—Blower speed

A blower is operating at a speed that is significantly outside the EMU specified range, possibly because of a bearing problem. This can cause the loss of cooling and cause an element to fail. The error remains active until the problem is corrected.

HP recommends replacing the blower as soon as possible.

To correct this problem, record all six characters of the condition report, then contact your authorized service representative.

### 0.3.en.03 UNRECOVERABLE condition—Blower failure

A blower has stopped. The operational blower now operates at high speed and is a single point of failure. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your authorized service representative.

### 0.3.en.04 UNRECOVERABLE condition—Blower internal

A power supply reported an internal blower error that could affect enclosure cooling and cause an element to fail. HP recommends correcting the problem before the blower fails. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your HP authorized service representative.

### 0.3.en.05 NONCRITICAL condition—Blower missing

A blower has been removed or is improperly installed. Even though the blower flaps close to maintain the proper air flow, the reduced cooling capability can cause overheating, causing an element to fail. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your HP authorized service representative.

### 0.3.en.06 UNRECOVERABLE condition—No blowers installed

**NOTE:**

IMPORTANT

When this condition exists there will be two error messages.

The first mssage will be *0.3.en.05* and will identify the first blower.

The second message will be *0.3.en.06* and will identify the second blower.

The EMU cannot detect any installed blowers. *Shutdown is imminent!* The EMU will shut down the enclosure in *seven minutes* unless you correct the problem. This condition report remains active until you correct the problem or the EMU shuts down the power supplies, whichever occurs first.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Use the controller shutdown procedure to shut down the controllers.
3. Contact your authorized service representative.

**CAUTION:**

An automatic shutdown and possible data corruption may result if the blower is removed before a replacement is available.

## Temperature conditions

The format of a temperature condition report is *0.4.en.ec*, where:

- *0.4.* is temperature sensor element type
- *en.* is the two-character temperature sensor element
- *ec* is the error code

Refer to Table 49 to determine the location of each temperature sensor.

**Table 49 Temperature sensor element numbering**

| Sensor | Sensor location | | Sensor | Sensor location |
|---|---|---|---|---|
| 01. | Power Supply 1 Exhaust | | 10. | Drive Bay 7 |
| 02. | Power Supply 2 Exhaust | | 11. | Drive Bay 8 |
| 03. | EMU | | 12. | Drive Bay 9 |
| 04. | Drive Bay 1 | | 13. | Drive Bay 10 |
| 05. | Drive Bay 2 | | 14. | Drive Bay 11 |
| 06. | Drive Bay 3 | | 15. | Drive Bay 12 |
| 07. | Drive Bay 4 | | 16. | Drive Bay 13 |
| 08. | Drive Bay 5 | | 17. | Drive Bay 14 |
| 09. | Drive Bay 6 | | | |

The following sections list the temperature condition reports and the default temperature thresholds. Use Command View EVA to view the temperature sensor ranges for the disk drives, EMU, and power supplies.

## 0.4.en.01 NONCRITICAL condition—High temperature

This condition report indicates that an element temperature is approaching, but has not reached, the high temperature CRITICAL threshold. Continued operation under these conditions may result in a CRITICAL condition. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Ensure that all elements are properly installed to maintain proper air flow.
3. Ensure that nothing is obstructing the air flow at either the front of the enclosure or the rear of the blower.
4. Ensure that both blowers are operating properly (the LEDs are on) and neither blower is operating at high speed.
5. Verify that the ambient temperature range is +10 °C to +35 °C (+50 °F to +95 °F). Adjust as necessary.
6. Observe the EMU to ensure the error is corrected.
7. If unable to correct the problem, contact your authorized service representative.

## 0.4.en.02 CRITICAL condition—High temperature

This condition report indicates that an element temperature is above the high temperature CRITICAL threshold. Continued operation under these conditions may result in element failure and may reduce an element MTBF. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Ensure that all elements are properly installed to maintain proper air flow.

3. Ensure that nothing is obstructing the air flow at either the front of the enclosure or the rear of the blower.
4. Ensure that both blowers are operating properly (the LEDs are on) and neither blower is operating at high speed.
5. Verify that the ambient temperature range is +10 °C to +35 °C (+50 °F to +95 °F). Adjust as necessary.
6. Observe the EMU to ensure the error is corrected.
7. If unable to correct the problem, contact your authorized service representative.

## 0.4.en.03 NONCRITICAL condition—Low temperature

This condition report indicates that an element temperature is approaching, but has not reached, the low temperature CRITICAL threshold. Continued operation under these conditions may result in a CRITICAL condition. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Verify that the ambient temperature rangeis +10 °C to +35 °C (+50 °F to +95 °F). Adjust as necessary.
3. Observe the EMU to ensure the error is corrected.
4. If the ambient temperature is correct and the problem persists, contact your Authorized Service Representative.

## 0.4.en.04 CRITICAL condition—Low temperature

This condition report indicates that an element temperature has reached the low temperature CRITICAL threshold. HP recommends correcting this error to prevent affecting other elements. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Verify that the ambient temperature range is +10 °C to +35 °C (+50 °F to +95 °F). Adjust as necessary.
3. Observe the EMU to ensure the error is corrected.
4. If the ambient temperature is correct and the problem persists, contact your authorized service representative.

## 0.4.en.05 UNRECOVERABLE condition—High temperature

This condition report indicates that the EMU has evaluated the temperature of the three temperature groups (EMU, disk drives, and power supplies), and determined that the average temperature of two of the three groups exceeds the critical level (use Command View EVA to view the temperature thresholds). Under these conditions the EMU starts a timer that will automatically shut down the enclosure in seven minutes unless you correct the problem. *Enclosure shutdown is imminent!*

△ **CAUTION:**

An automatic shutdown and possible data corruption may result if the procedure below is not performed immediately.

Complete the following procedure to correct this problem.

1. Ensure that all disk drives, I/O modules, and power supply elements are fully seated.

2. Ensure that all blowers are operating properly.
3. Verify that the ambient temperature range is +10 °C to +35 °C (+50 °F to +95 °F). Adjust as necessary.
4. If Steps 1, 2 or 3 did not reveal a problem, use Command View EVA to request the HSV110 controller to shut down the drive enclosure. Completing this action will halt the drive enclosure data transfers.
5. Contact your authorized service representative and request assistance.

## EMU conditions

The format of an EMU condition report is *0.7.01.ec*, where:

- *0.7.* is the EMU element type number
- *01.* is the two-character EMU element number
- *ec* is the error code

**NOTE:**

IMPORTANT

There is only one EMU in a drive enclosure. Therefore, the element number is always 01.

### Resetting the EMU

In some cases, the only corrective action for an EMU error is to replace the EMU. Call your authorized service representative if this action is required. Another option is to reset the EMU using the following procedure.

1. Firmly grasp the EMU mounting handle and pull the EMU partially out of the enclosure.

**NOTE:**

IMPORTANT

You do not need to remove the EMU from the enclosure, nor to disconnect the cables. You must avoid putting any strain on the cables or connectors.

2. Wait 30 seconds, and then push the EMU in and fully seat the element in the backplane. The EMU should display any enclosure condition report within two minutes.

### 07.01.01 CRITICAL condition—EMU internal clock

There is an internal EMU clock error that will remain active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Reset the EMU.
3. If resetting the EMU did not correct the problem, replace the EMU.
4. Observe the EMU to ensure the error is corrected.
5. If unable to correct the problem, contact your HP authorized service representative.

### 07.01.02 UNRECOVERABLE condition—EMU interrupted

The Inter-IC (I2C) bus is not processing data and the EMU is unable to monitor or report the status of the elements or enclosures. *IMMEDIATE* corrective action is required to ensure proper enclosure operation. This condition report remains active until the problem is corrected.

Complete the following procedure *NOW* to correct this problem.

1. Record all six characters of the condition report.
2. Reset the EMU.
3. Observe the EMU to ensure the error is corrected.
4. If resetting the EMU did not correct the problem, replace the EMU.
5. If unable to correct the problem, contact your HP authorized service representative.

### 0.7.01.03 UNRECOVERABLE Condition—Power supply shutdown

This message only appears on the Command View EVA GUI to report a power supply has already shut down. This message can be the result of the controller shutdown command or an EMU or power supply initiated power shutdown.

This message cannot be displayed until after restoration of power. Therefore, there is no corrective action required.

### 0.7.01.04 INFORMATION condition—EMU internal data

The EMU is unable to collect data for the SCSI-3 Engineering Services (SES) page. This condition report remains active for 15 seconds. The condition report affects only internal EMU operations. There is no degradation of enclosure operations.

The EMU initiates automatic recovery procedures.

If the problem is not automatically corrected after one minute, contact your HP authorized service representative.

### 0.7.01.05 UNRECOVERABLE condition—Backplane NVRAM

**NOTE:**

IMPORTANT

Backplane NVRAM errors usually occur during manufacture. At this time they are identified and corrected. They rarely occur during normal operation.

When a backplane NVRAM is not programmed or cannot be read by the EMU, there is no communication with the disk drives. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Reset the EMU.
3. Observe the EMU to ensure the error is corrected.
4. If resetting the EMU did not correct the problem, contact your HP authorized service representative.

### 0.7.01.10 NONCRITICAL condition—NVRAM invalid read data

The data read from the EMU NVRAM is invalid. This error initiates an automatic recovery process. This condition report remains active until the problem is corrected.

If the automatic recovery process does not correct the problem, complete the following procedure.

1. Record all six characters of the condition report.
2. Reset the EMU.
3. Observe the EMU to ensure the error is corrected.

4. If resetting the enclosure did not correct the problem, contact your HP authorized service representative.

### 0.7.01.11 NONCRITICAL condition—EMU NVRAM write failure

The EMU cannot write data to the NVRAM. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Reset the EMU.
3. Observe the EMU to ensure the error is corrected.
4. If resetting the enclosure did not correct the problem, contact your HP authorized service representative.

### 0.7.01.12 NONCRITICAL condition—EMU cannot read NVRAM data

The EMU is unable to read data from the NVRAM. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Reset the EMU.
3. Observe the EMU to ensure the error is corrected.
4. If resetting the enclosure did not correct the problem, contact your HP authorized service representative.

### 0.7.01.13 UNRECOVERABLE condition—EMU load failure

The EMU Field Programmable Gate Array (FPGA) that controls the ESI bus failed to load information required for EMU operation. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Reset the EMU.
3. Observe the EMU to ensure the error is corrected.
4. If resetting the enclosure did not correct the problem, contact your HP authorized service representative.

### 0.7.01.14 NONCRITICAL condition—EMU enclosure address

Either the enclosure address is incorrect or the enclosure has no address. Possible causes include a defective enclosure address bus cable, an incorrectly connected cable, or a defective enclosure address bus JB. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Remove and reconnect the cable between the address bus JB and the EMU.

**NOTE:**

The EMU display may not display a change in condition for up to 30 seconds.

3. Observe the EMU to ensure the error is corrected.
4. If the prolem is not corrected, remove and reinstall the bottom and top terminators, and all the JB-to-JB cables.
5. Observe the EMU to ensure the error is corrected.
6. Reset the EMU, then observe the EMU to ensure the error is corrected.
7. If resetting the EMU did not correct the problem, contact your HP authorized service representative.

### 0.7.01.15 UNRECOVERABLE condition—EMU hardware failure

The EMU has detected an internal hardware problem. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Reset the EMU.
3. Observe the EMU to ensure the error does not recur within the first minute.
4. If the error does recur, contact your HP authorized service representative. The EMU is inoperative and must be replaced as soon as possible.

### 0.7.01.16 INFORMATION condition—EMU internal ESI data corrupted

The EMU ESI data is corrupted. This condition does not affect any other element and no action is required.

### 0.7.01.17 UNRECOVERABLE condition—Power shutdown failure

The power supply did not respond to a controller, EMU, or power supply shut down command. Shutting down the supply is required to prevent overheating.

Complete the following procedure to correct the problem:

1. Record all six characters of the condition report.
2. Move the power cord bail lock 1, Figure 78, to the left.
3. Disconnect the AC power cord 2 from the supply.

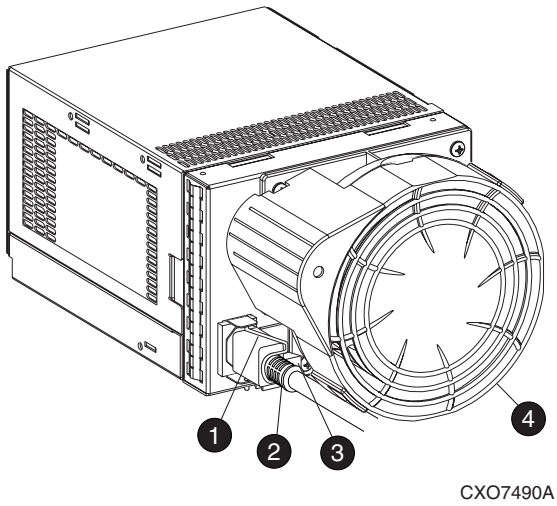



**Figure 78 Disconnecting AC power**

## 0.7.01.18 UNRECOVERABLE condition—EMU hardware failure

The EMU has detected an internal hardware problem. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Reset the EMU.
3. Observe the EMU to ensure the error does not recur within the first minute.
4. If the error does recur, contact your HP authorized service representative. The EMU is inoperative and must be replaced as soon as possible.

## 0.7.01.19 UNRECOVERABLE condition—EMU ESI driver failure

The EMU has detected an internal hardware problem. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Reset the EMU.
3. Observe the EMU to ensure the error does not recur within the first minute.
4. If the error does recur, contact your HP authorized service representative. The EMU is inoperative and must be replaced as soon as possible.

# Transceiver conditions

The format of a transceiver condition report is *0.F.en.ec*, where:

- *0.F.* is the transceiver element type number
- *en.* is the two-character transceiver element number (see Figure 79)
- *ec* is the error code

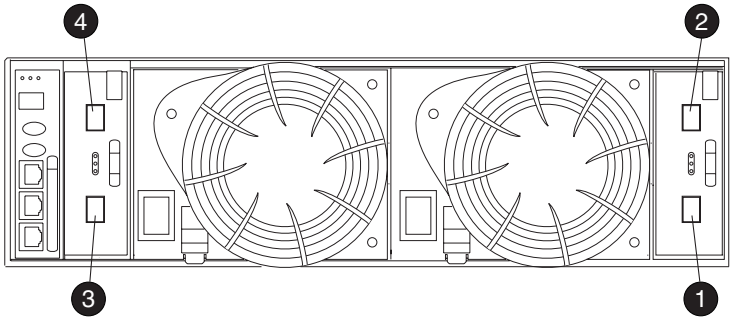



**Figure 79 Transceiver element numbering**

1. Transceiver 01
2. Transceiver 02
3. Transceiver 03
4. Transceiver 04

## 0.F.en.01 CRITICAL Condition—Transceiver Incompatibility

The transceivers on this link are not the same type or they are incompatible with the I/O module. This error prevents the controller from establishing a link with the enclosure drives and eliminates the enclosure dual-loop capability. This error remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your HP authorized service representative.

## 0.F.en.02 CRITICAL Condition—Transceiver Data Signal Lost

This symptom can occur when a controller has been powered off or a cable has been removed from the transceiver. The transceiver can no longer detect a data signal. This error prevents the controller from transferring data on a loop and eliminates the enclosure dual-loop capability. This error remains active until the problem is fixed.

To correct this problem, record all six characters of the condition report, then contact your HP authorized service representative.

## 0.F.en.03 CRITICAL Condition—Transceiver FC-AL Bus Fault

The system has detected an FC-AL bus fault involving a transceiver. This error prevents the controller from transferring data on a loop ad eliminates the enclosure dual-loop capability.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Check all the transceivers and cables to ensure they are properly connected.
3. Check all the transceivers on the loop to ensure they are compatible with the I/O module.
4. If the problem persists, contact your HP authorized service representative.

## 0.F.en.04 CRITICAL Condition—Transceiver Removed

The EMU detects that a transceiver has been removed. This error remains active until the problem is fixed.

The error can be cleared by doing one of the following:

1. Install a new transceiver,

   or

Reconfigure the system by switching from a loop topology to one with Vixel switches, then the transceiver is not necessary.

2. Clear the error by resetting the EMU or by removing and then re-installing the I/O module.

### 0.F.en.05 CRITICAL Condition—Invalid Fibre Channel Character

This symptom can occur under the following conditions:

- The incoming data stream is corrupted.
- A cable is not completely connected.
- The signal is degraded.

This error prevents the controller from transferring data on a loop and eliminates the enclosure dual-loop capability. This error remains active until the problem is fixed.

To correct this problem, record all six characters of the condition report, then contact your HP authorized service representative.

## Voltage sensor and current sensor conditions

The format of these sensor condition reports is *1.2.en.ec* for a voltage sensor, and *1.3.en.ec* for a current sensor, where:

- *1.2.* is the voltage sensor element type
- *1.3.* is the current sensor element type number
- *en.* is the sensor element number
- *ec* is the error code

Table 50 lists the location of the power supply voltage and current sensors.

**Table 50 Voltage and Current Sensor Locations**

| Sensor | Sensor Element Location |
|---|---|
| 01. | Power Supply 1 +5 VDC |
| 02. | Power Supply 1 +12 VDC |
| 03. | Power Supply 2 +5 VDC |
| 04. | Power Supply 2 +1 VDC |

Use Command View EVA to view the voltage and current error thresholds for both +5 VDC and +12 VDC power supplies.

### 1.2.en.01 NONCRITICAL Condition—High Voltage

This condition report indicates that an element voltage is approaching, but has not reached, the high voltage CRITICAL threshold. Continued operation under these conditions may result in a CRITICAL condition. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your HP authorized service representative.

### 1.2.en.02 CRITICAL Condition—High Voltage

This condition report indicates that an element voltage has reached the high voltage CRITICAL threshold. This report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your HP authorized service representative.

### 1.2.en.03 NONCRITICAL Condition—Low Voltage

This condition report indicates that an element voltage is approaching, but has not reached, the low voltage CRITICAL threshold. Continued operation under these conditions may result in a CRITICAL condition. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your HP authorized service representative.

### 1.2.en.04 CRITICAL Condition—Low Voltage

This condition report indicates that an element voltage has reached the low voltage CRITICAL threshold. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your HP authorized service representative.

### 1.3.en.01 NONCRITICAL Condition—High Current

This condition report indicates that an element current is approaching, but has not reached, the high current CRITICAL threshold. Continued operation under these conditions may result in a CRITICAL condition. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your HP authorized service representative.

### 1.3.en.02 CRITICA Condition—High Current

This condition report indicates that an element current has reached the high current CRITICAL threshold. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your HP authorized service representative.

## Backplane conditions

**IMPORTANT:**

Backplane NVRAM errors usually occur during manufacture. At this time they are identified and corrected. They rarely occur during normal operation.

The format of a backplane condition report is *8.2.01.ec*, where:

- *8.2.* is the backplane element type number
- *01.* is the two-character backplane element number
- *ec* is the error code

The only corrective action available for this error is to replace the drive enclosure.

### 8.2.01.10 NONCRITICAL condition—Backplane NVRAM read

An invalid NVRAM read occurred and an automatic recovery process has begun. This condition report is active for 15 seconds.

If the automatic recovery process does not correct the problem, record all six characters of the condition report, then contact your HP authorized service representative.

### 8.2.01.11 NONCRITICAL condition—Backplane NVRAM write failure

The system is unable to write data to the NVRAM. This problem prevents communication between elements in the enclosure. This condition report is active for 15 seconds.

To correct this problem, record all six characters of the condition report, then contact your HP authorized service representative.

### 8.2.01.12 NONCRITICAL condition—Backplane NVRAM read failure

The system is unable to read data from the NVRAM. This problem prevents communication between elements in the enclosure. This condition report is active for 15 seconds.

To correct this problem, record all six characters of the condition report, then cntact your HP authorized service representative.

### 8.2.01.13 NONCRITICAL condition—Backplane WWN is blank

The system is unable to read valid data from the NVRAM. This report is active until corrected. This condition can result in incorrect device location data being displayed.

To correct this problem, record all six characters of the condition report, then contact your HP authorized service representative.

## I/O Module conditions

The format of an I/O module condition report is *8.7.en.ec*, where:

- *8.7.* is the I/O module element type number
- *en.* is the two-character I/O module element number (see Figure 80)
- *ec* is the error code

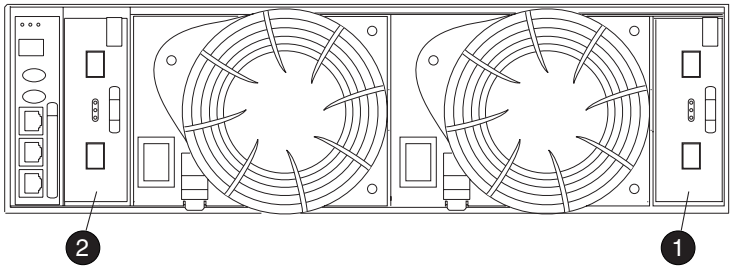



**Figure 80 I/O module element numbering**

1. I/O Module A (01)
2. I/O Module B (02)

Correction of an I/O module problem normally requires replacing the module. The following sections define the I/O module problem by I/O module location.

### 8.7.en.01 CRITICAL condition—I/O module unsupported

The I/O module Fibre Channel link speed is not supported by the backplane. This error prevents the controller from establishing a link with enclosure drives and eliminates the enclosure dual-loop capability. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your HP authorized service representative.

### 8.7.en.02 CRITICAL condition—I/O module communication

The I/O module is unable to communicate with the EMU.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Contact your HP authorized service representative.

**IMPORTANT:**

Multiple erroneous error messages indicating I2C bus errors, such as NVRAM errors, blowers missing, and so forth, could indicate an EMU problem.

### 8.7.en.10 NONCRITICAL condition—I/O module NVRAM read

An invalid NVRAM read occurred and automatic recovery was initiated.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Observe the I/O module status LEDs for an operational display.
3. Contact your HP authorized service representative.

### 8.7.en.11 NONCRITICAL condition—I/O module NVRAM write

The system is unable to write data to the I/O module NVRAM.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Observe the I/O module status LEDs for an operational display.
3. Contact your HP authorized service representative.

### 8.7.en.12 NONCRITICAL condition—I/O Module NVRAM read failure

The system is unable to read data from the I/O module NVRAM.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Contact your HP authorized service representative.

### 8.7.en.13 NONCRITICAL condition—I/O module removed

The system detects that an I/O module has been removed.

To correct the problem, install an I/O module.

## Host conditions

The EMU has the capability of displaying host controller defined condition reports on the EMU alphanumeric display.

The format of a host condition report is *F.F.en.ec*, where:

- *F.F.* is the host element type number
- *en.* is the two-character host element number
- *ec* is the error code

The host controller can display host controller defined error codes on the EMU alphanumeric display

# C Controller fault management

This appendix describes how the controller displays events and termination event information. Termination event information is displayed on the LCD. The Command View EVA GUI enables you to view controller events. This appendix also discusses how to identify and correct problems.

Once you create a storage system, as described in Chapter 2, "Setting Up a Controller Pair Using the OCP," an error condition message has priority over other controller displays.

The Command View EVA GUI provides detailed descriptions of the storage system error conditions, or faults. The Fault Management displays provide similar information on the LCD, but not in as much detail. Whenever possible, refer to the GUI for fault information.

## Using the Command View EVA GUI

The Command View EVA GUI display provides detailed information about each event affecting system operation in either a Termination Event display or an Event display. These displays are similar, but not identical.

## GUI termination event display

A problem that generates the Termination Event display prevents the system from performing a specific function or process. You can use the information in this display (see GUI Termination Event Display) to diagnose and correct the problem.

NOTE:

The major differences between the Termination Event display and the Event display are:

- The Termination Event display includes a Code Flag field; it does not include the EIP Type field.
- The Event display includes an EIP type field; it does not include a Code Flag field.
- The Event display includes a Corrective Action Code field.

| Date | Time | SWCID | Evt No | Code Flag | Descrip-<br>tion |
|---|---|---|---|---|---|

**Figure 81 GUI termination event display**

The fields in the Termination Event display include:

- Date—The date the event occurred.
- Time—The time the event occurred.
- SWCID—Software Identification Code. A hexadecimal number in the range 0–FF that identifies the controller software component reporting the event.
- Evt No—Event Number. A hexadecimal number in the range 0–FF that is the software component identification number.
- Code Flag—An internal code that includes a combination of other flags.
- Description—The condition that generated the event. This field may contain information about an individual field's content and validity.

## GUI event display

A problem that generates the Event display reduces the system capabilities. You can use the information in this display (see Figure 82) to diagnose and correct problems.

**NOTE:**

The major differences between the Event Display and the Termination Event display are:

- The Event display includes an EIP type field; it does not include a Code Flag field.
- The Event display includes a Corrective Action Code (CAC) field.
- The Termination Event display includes a Code Flag field; it does not include the EIP Type field.

| Date | Time | SWCID | Evt No | CAC | EIP Type | Descrip-tion |
|---|---|---|---|---|---|---|

**Figure 82 Typical Command View EVA Event display**

The Event display provides the following information:

- Date—The date the event occurred.
- Time—The time the even occurred.
- SWCID—Software Identification Code. A number in the range 1–256 that identifies the internal firmware module affected.
- Evt No—Event Number. A hexadecimal number in the range 0–FF that is the software component identification number.
- CAC—Corrective Action Code. A specific action to correct the problem.
- EIP Type—Event Information Packet Type. A hexadecimal character that defines the event information format.
- Description—The problem that generated the event.

## Fault management displays

When you do not have access to the GUI, you can display and analyze termination codes (TCs) on the OCP LCD display. You can then use the event text code document, as described in the section titled "Interpreting Fault Management Information" to determine and implement corrective action. You can also provide this information to the authorized service representative should you require additional support. This lets the service representative identify the tools and components required to correct the condition in the shortest possible time.

When the Fault Management display is active (flashing), you can either display the last fault or display detailed information about the last 32 faults reported.

### Displaying Last Fault Information

Complete the following procedure to display Last Fault information

1. When the Fault Management display is active (flashing), press ▶ to select the Last Fault menu.
2. Press ▶ to display the last fault information.

   The first line of the TC display contains the eight-character TC error code and the two-character IDX (index) code. The IDX is a reference to the location in the TC array that contains this error. The second line of the TC display identifies the affected parameter with a two-character parameter number (0–30), the eight-character parameter code affected, and the parameter code number.
3. Press ◀ to return to the Last Fault menu.

## Displaying Detailed Information

The Detail View menu lets you examine detailed fault information stored in the Last Termination Event Array (LTEA). This array stores information for the last 32 termination events.

Complete the following procedure to display the LTEA information about any of the last 32 termination events:

1. When the Fault Management display is active (flashing), press ▼to select the Detail View menu.
   The LTEA selection menu is active (LTEA 0 is displayed).
2. Press ▼ or ▲ to increment to a specific error, LTEA N, in this example.
3. Press ▶ to observe data about the selected error, LTEA N, in this example.

## Interpreting Fault Management Information

Each version of the Command View EVA application includes an ASCII text file that defines all the codes that the authorized service representative can view either on the GUI or on the OCP.

**IMPORTANT:**

This information is for the exclusive use of the authorized service representative.

The file name identifies the file type and the revision date. For example, the file name *hsv110_event_w010605_t100.txt* provides the following information:

- `hsv110_`—the Network Storage Controller (NSC) model number string, that is the controller model number
- `event_`—the type of information in the file.
- `w010605_`—the NSC base level build string, that is, the file creation date.
  - `01`—creation year
  - `06`—creation month
  - `05`—creation date
- `t100`—the NSC software version number string.

Table 51 describes types of information available in this file.

**Table 51 Controller Event Text Description File**

| Information Type | Description |
|---|---|
| Event Code | This hexadecimal code identifies the reported event type. |
| Termination Code (TC) | The hexadecimal code specifies the condition that generated the termination code. It might also define either a system or user initiated corrective action. |
| Coupled Crash Control Codes | This single digit, decimal character defines the requirement for the other controller to initiate a coupled crash control.0. Other controller SHOULD NOT complete a coupled crash.1. Other controller SHOULD complete a coupled crash. |
| Dump/Restart Control Codes | This single decimal character (0, 1, 3) defines the requirement to:0. Perform a crash dump and then restart the controller.1. DO NOT perform a crash dump; just restart the controller.3. DO NOT perform a crash dump; DO NOT restart the controller |
| Corrective Action Codes (CAC) | These hexadecimal codes supplement the Termination Code information to identify the faulty element and the recommended corrective action. |
| Software Component ID Codes (SWCID) | These decimal codes identify software associated with the event. |
| Event Information Packets (EIP) | These codes specify the packet organization for specific type events. |

# D Customer replaceable units

This appendix describes the procedures for replacing CRUs. Information about initial enclosure installation, ESD protection, and common replacement procedures is also presented.

## ESD protection

When you replace a CRU, you must take precautions to prevent the possibility of electrostatic discharge (ESD) damaging sensitive electronic items.

1. *Always* transport and store CRUs in an ESD protective enclosure.
2. Do not remove the CRU from the ESD protective enclosure until you are ready to install it.
3. Always use ESD precautions, such as a wrist strap, heel straps on conductive flooring, and an ESD protective smock when handling ESD sensitive equipment.
4. Avoid touching the CRU connector pins, leads, or circuitry.

**NOTE:**

Do not place ESD generating material such as paper or non anti-static (pink) plastic in an ESD protective enclosure with ESD sensitive equipment.

## Common replacement procedures

The following procedure is common to all CRU replacement procedures.

**CAUTION:**

The hotpluggable power supplies, blowers, and drives DO NOT require halting Fibre Channel data transfers.

Replacing a pluggable I/O module, transceiver, or a fiber cable always interrupts data transfers on the Fibre Channel loop.

Review the controller documentation to determine if replacing an I/O module, transceiver or fiber cable requires removing power.

1. Always implement all the ESD protection procedures.
2. Disconnect external cables from the CRU and make note of the connection.
3. Remove the defective CRU from the enclosure.
4. Remove the replacement CRU from the ESD protective enclosure. Check the label to ensure that the CRU is a compatible replacement (see Figure 83).
5. Align the CRU with the enclosure guide slots.
6. Reconnect external cables to restore external connections.
7. Slide the CRU into the enclosure until the CRU is against the backplane connector.
8. Fully seat the CRU in the enclosure and verify that the CRU is operating properly.
9. Place the defective CRU in the ESD protective enclosure for shipment.

# Determining CRU part numbers

All elements have a 6–3 spare part number on the product label (see Figure 83). This nine-character number appears immediately below the “Replace with HP Spare” statement. The first six characters (123479) identify the element. The last three characters (–002) define the revision level. The replacement element revision level must be the same as, or greater than, the number on the element being replaced. The higher the revision level, the later the revision.




**Figure 83 Typical product label**

# Replacing a disk drive

**NOTE:**

For the latest information and instructions about disk drives, such as compatibility and installation instructions, go to the HP web site: http://www.hp.com.

To replace a disk drive:

**CAUTION:**

Remove only one drive at a time and replace it with a drive of equal or greater capacity to avoid data loss. Allow the system to migrate data onto the replacement drive as indicated by the drive operational status in Command View EVA.

**CAUTION:**

Remove only one drive or drive blank at a time to avoid overheating the enclosure and to provide an electro-magnetic EM shield for the enclosure. Replace with another drive or drive blank to ensure proper air flow and EM shielding.

1. Push in on the disk drive Ejector Button 1 (see Figure 84), and pivot the Release Lever 2 to the full, open position

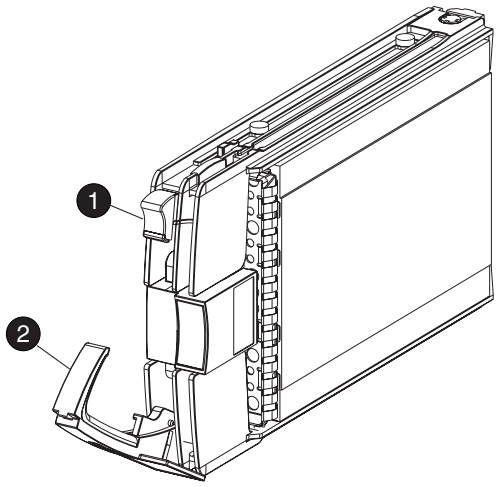



**Figure 84 Removing a drive**

2. Pull on the drive until it disconnects from the backplane connector.

△ CAUTION:

The carrier can be dropped due to the rapidly rotating media. To prevent equipment failure, remove the carrier from the enclosure when the media has stopped rotating. This takes approximately 30 seconds.

3. When you are sure that the media is no longer spinning, completely remove the drive from the enclosure.
4. Insert the replacement drive into the enclosure until the drive is against the backplane connector.
5. Push in the replacement drive while pivoting the Release Lever 2 to the full upright position.
6. Push in the Release Lever until the lever engages the Ejector Button 1, and the drive fully seats in the backplane connector.
7. Observe the drive status LEDs to ensure the replacement drive is functioning properly. Refer to your drive enclosure user guide for specific details.

## Inserting disk drives into a running EVA

The following EVA operational restriction applies to all currently available versions of VCS.

When inserting more than 4 disk drives into an existing configuration that is running, the disk drives must be inserted in sets of 4 or fewer drives using the following procedure. This procedure must be followed to avoid unexpected EVA system behavior.

1. Insert a set of 1 to 4 disk drives into the drive enclosures of the EVA so that each drive is fully seated and the locking mechanism is fully engaged.
2. Wait until the activity lights (down arrow) on all drives inserted in Step 1 have changed to the solid green indication and remain in that state for 10 seconds.

**NOTE:**

If one or more of the disk drives inserted does not reach the solid green indication after 70 seconds, remove the drive or drives and check for damaged connectors on the disk drive and drive enclosure.

If no damage is found, repeat Steps 1 and 2. After two attempts, replace drives that do not reach the solid green indication. When all of the inserted disk drives successfully reach the solid green indication, then repeat Steps 1 and 2 for the next set of 1 to 4 disk drives to be inserted.

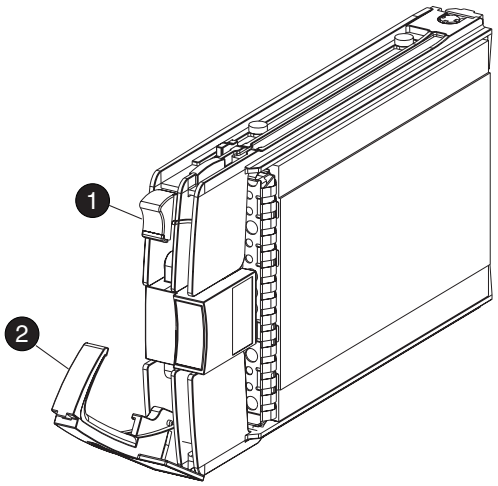
**NOTE:**

Drive insertion refers to physically inserting drives into drive enclosure slots. It is not synonymous with drive addition to a disk group.

# How to install a drive blank

Complete the following procedure to replace a disk drive with a drive blank.

1. Push in the disk drive port wine-colored Ejector Button 1 (see Figure 85) and pivot the Release Lever 2 to the full, open position.




CXO6826A

**Figure 85 Removing a drive to install a drive blank**

2. Pull on the drive to disconnect from the backplane connector.

**CAUTION:**

The carrier can be dropped due to the rapidly rotating media. To prevent equipment failure, remove the carrier from the enclosure when the media has stopped rotating. This takes approximately 30 seconds.

3. When you are sure that the media is no longer spinning, remove the drive from the enclosure.
4. Insert the drive blank (see Figure 86) into the enclosure bay until the locking tabs engage the enclosure.

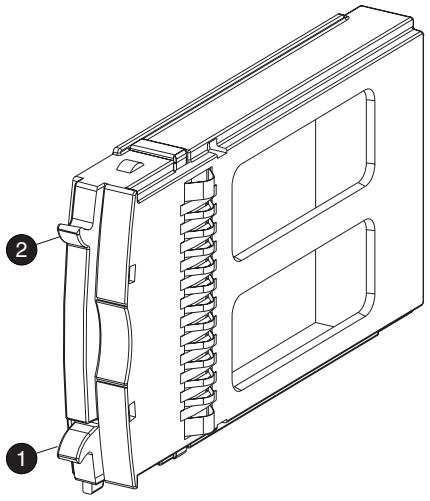



**Figure 86 Installing and removing a drive blank**

**NOTE:**

When installing drives, start at slot one, and do not leave blank slots between drives. If mixing online and near-online drives, a minimum of 8 online and 8 near-online drives are required. When loading drives into racks, align drives vertically by capacity.

# How to remove a drive blank

Complete the following procedure to remove a drive blank.

1. Grasp the drive blank by the two tabs (1 and 2, Figure 86).
2. Lift up on the bottom tab 1 and pull the blank out of the enclosure.

# Protecting fiber optic connections

This section provides protection and cleaning methods for fiber optic connectors.

Contamination of the fiber optic connectors on either a transceiver or a cable connector can impede the transmission of data. Therefore, protecting the connector tips against contamination or damage is imperative. The tips can be contaminated by touching them, by dust, or by debris. They can be damaged when dropped. To protect the connectors against contamination or damage, use the dust covers or dust caps provided by the manufacturer. These covers are removed during installation, and are installed whenever the transceivers or cables are disconnected. Cleaning the connectors should remove contamination.

The transceiver dust caps protect the transceivers from contamination.

**CAUTION:**

To avoid damage to the connectors, always install the dust covers or dust caps whenever a transceiver or a fiber cable is disconnected. Remove, *but do not discard*, the dust covers or dust caps from transceivers or fiber cable connectors only when they are connected.

To minimize the risk of contamination or damage, do the following:

- **Dust Covers**—Remove *and retain* the dust covers and dust caps when installing an I/O module, a transceiver or a cable. Install the dust covers when disconnecting a transceiver or cable.
- **When to Clean**—If a connector may be contaminated, or if a connector has not been protected by a dust cover for an extended period of time, clean it.
- **How to Clean**:

  a. Wipe the connector with a lint-free tissue soaked with 100% isopropyl alcohol.
  b. Wipe the connector with a dry, lint-free tissue.
  c. Dry the connector with moisture-free compressed air.

One of the many sources for cleaning equipment specifically designed for fiber optic connectors is:

Alcoa Fujikura Ltd.

1-888-385-4587 (North America)

011-1-770-956-7200 (International)

# Glossary

This glossary defines terms used in this guide or related to this product and is not a comprehensive glossary of computer terms.

**µm**
A symbol for micrometer; one millionth of a meter. For example, 50 µm is equivalent to 0.000050 m.

**3U**
A unit of measurement representing three "U" spaces. "U" spacing is used to designate panel or enclosure heights. Three "U" spaces is equivalent to 5.25 inches (133 mm).
*See also* rack-mounting unit.

**active member of a virtual disk family**
An active member of a virtual disk family is a simulated disk drive created by the controllers as storage for one or more hosts. An active member of a virtual disk family is accessible by one or more hosts for normal storage. An active virtual disk member and its snapshot, if one exists, constitute a virtual disk family. An active member of a virtual disk family is the only necessary member of a virtual disk family.
*See also* virtual disk,virtual disk copy,virtual disk family,and snapshot.

**adapter**
*See* controller.

**AL_PA**
Arbitrated Loop Physical Address. A 1-byte value the arbitrated loop topology uses to identify the loop ports. This value becomes the last byte of the address identifier for each public port on the loop.

**allocation policy**
Storage system rules that govern how virtual disks are created. Allocate Completely and Allocate on Demand are the two rules used in creating virtual disks.

- Allocate Completely—The space a virtual disk requires on the physical disks is reserved, even if the virtual disk is not currently using the space.
- Allocate on Demand—Thespace a virtual disk requires on the physical disks is not reserved until needed.

**ambient temperature**
The air temperature in the area where a system is installed. Also called intake temperature or room temperature.

**ANSI**
American National Standards Institute. A non-governmental organization that develops standards (such as SCSI I/O interface standards and Fibre Channel interface standards) used voluntarily by many manufacturers within the United States.

**arbitrated loop**
A Fibre Channel topology that links multiple ports (up to 126) together on a single shared simplex media. Transmissions can only occur between a single pair of nodes at any given time. Arbitration is the scheme that determines which node has control of the loop at any given moment

**arbitrated loop physical address**
*See* AL_PA.

**arbitrated loop topology**
*See* arbitrated loop.

**array** All the physical disk drives in a storage system that are known to and under the control of a controller pair.

**array controller** *See* controller.

**asynchronous** Events scheduled as the result of a signal requesting the event or that which is without any specified time relation.

**audible alarm** The Environmental Monitoring Unit (EMU) alarm that sounds when there is a disk drive enclosure element condition report. The audible alarm can be muted or disabled.

**backplane** An electronic printed circuit board that distributes data, control, power, and other signals to element connectors.

**bad block** A data block that contains a physical defect.

**bad block replacement** A replacement routine that substitutes defect-free disk blocks for those found to have defects. This process takes place in the controller and is transparent to the host.

**bail lock** Part of the power supply AC receptacle that engages the AC power cord connector to ensure that the cord cannot be accidentally disconnected.

**baud** The maximum rate of signal state changes per second on a communication circuit. If each signal state change corresponds to a code bit, then the baud rate and the bit rate are the same. It is also possible for signal state changes to correspond to more than one code bit so the baud rate may be lower than the code bit rate.

**bay** The physical location of an element, such as a drive, I/O module, EMU or power supply in a drive enclosure. Each bay is numbered to define its location.

**bidirectional** *Also* called Bi-Di. The movement of optical signals in opposite directions through a common fiber cable such as the data flow path typically on a parallel printer port. A parallel port can provide two-way data flow for disk drives, scanning devices, FAX operations and even parallel modems.

**block** Also called a sector. The smallest collection of consecutive bytes addressable on a disk drive. In integrated storage elements, a block contains 512 bytes of data, error codes, flags, and the block address header.

**blower** A variable speed airflow device that pulls air into an enclosure or element. It usually pulls air in from the front and exhausts the heated air out the rear.

**cabinet** An alternate term used for a rack.

**cable assembly** A fiber optic cable that has connectors installed on one or both ends. General use of these cable assemblies includes the interconnection of multimode fiber optic cable assemblies with either LC or SC type connectors.

- When there is a connector on only one end of the cable, the cable assembly is referred to as a pigtail.
- When there is a connector on each end of the cable, the cable assembly is referred to as a jumper.

**CAC** Corrective Action Code. A Command View EVA graphical user interface (GUI) display component that defines the action required to correct a problem. *See also* read cache,write cache, and mirrored cache.

**cache** High-speed memory that sets aside data as an intermediate data buffer between a host and the storage media. The purpose of cache is to improve performance.

**cache battery** A rechargeable unit mounted within a controller enclosure that supplies back-up power to the cache module in case of primary power shortage.

**cache battery LED**
1. An orange light emitting diode (LED) that illuminates on the controller operator control panel (OCP) to define the status of the HSV Controller cache batteries.
2. An amber status LED that illuminates on a cache battery. When illuminated, it indicates that one or more cache battery cells have failed and the battery must be replaced with a new battery.

**carrier** A drive-enclosure-compatible assembly containing a disk drive or other storage devices.

**client** A software program that uses the services of another software program. The Command View EVA client is a standard internet browser.

**clone** *See* Virtual Disk Copy.

**communication logical unit number (LUN)** *See* console LUN.

**condition report** A three-element code generated by the EMU in the form where e.t. is the element type (a hexadecimal number), en. is the element number (a decimal number), and ec is the condition code (a decimal number).

**console LUN** A SCSI-3 virtual object that makes a controller pair accessible by the host before any virtual disks are created. *Also* called a communication LUN.

**console LUN ID** The ID that can be assigned when a host operating system requires a unique ID. The console LUN ID is assigned by the user, usually when the storage system is initialized.
*See also* console LUN.

**controller** A hardware/firmware device that manages communications between host systems and other devices. Controllers typically differ by the type of interface to the host and provide functions beyond those the devices support.

**controller enclosure** A unit that holds one or more controllers, power supplies, blowers, cache batteries, transceivers, and connectors.

**controller event** A significant occurrence involving any storage system hardware or software component reported by the controller to Command View EVA.

**controller fault LED** An amber fault LED that illuminates on the controller OCP to indicate when there is an HSV Controller fault.

**controller pair** Two interconnected controller modules which together control a physical disk array. A controller pair and the disk array together constitute a storage system.

**corrective action code** *See* CAC.

**CRITICAL Condition** A disk drive enclosure EMU condition that occurs when one or more disk drive enclosure elements have failed or are operating outside of their specifications. The failure of the element makes continued normal operation of at least some elements in the enclosure impossible. Some enclosure elements may be able to continue normal operations. Only an UNRECOVERABLE condition has precedence. This condition has precedence over NONCRITICAL errors and INFORMATION condition.

**CRU** Customer Replaceable Unit. A storage system element that a user can replace without using special tools or techniques, or special training.

**customer replaceable unit** *See* CRU.

**data entry mode** The state in which controller information can be displayed or controller configuration data can be entered. On the Enterprise Storage System, the controller mode is active when the LCD on the HSV Controller OCP is Flashing.

**default disk group** The first disk group created at the time the system in initialized. The default diskgroup can contain the entire set of physical disks in the array or just a few of the disks.
*See also* disk group.

**Detailed Fault View** An HSV Controller OCP display that permits a user to view detailed information about a controller fault.

**device channel** A channel used to connect storage devices to a host I/O bus adapter or intelligent controller.

**device ports** Controller pair device ports connected to the storage system's physical disk drive array through the FC-AL. *Also* called a device-side port.

**device-side ports** *See* device ports.

**DIMM** Dual Inline Memory Module. A small circuit board holding memory chips.

**dirty data** The write-back cached data that has not been written to storage media even though the host operation processing the data has completed.

**disk drive** A carrier-mounted storage device supporting random access to fixed size blocks of data.

**disk drive blank** A carrier that replaces a disk drive to control airflow within a drive enclosure whenever there is less than a full complement of storage devices.

**disk drive enclosure** A unit that holds storage system devices such as disk drives, power supplies, blowers, I/O modules, transceivers, or EMUs.

**disk drive enclosure event** A significant operational occurrence involving a hardware or software component in the disk drive enclosure. The disk drive enclosure EMU reports these events to the controller for processing.

**disk failure protection** A method by which a controller pair reserves drive capacity to take over the functionality of a failed or failing physical disk. For each disk group, the controllers reserve space in the physical disk pool equivalent to the selected number of physical disk drives.

**disk group** A physical disk drive set or pool in which a virtual disk is created. A disk group may contain all the physical disk drives in a controller pair array or a subset of the array.

**disk migration state** A physical disk drive operating state. A physical disk drive can be in a stable or migration state:

- Stable—The state in which the physical disk drive has no failure nor is a failure predicted.
- Migration—The state in which the disk drive is failing, or failure is predicted to be imminent. Data is then moved off the disk onto other disk drives in the same disk group.

**disk replacement delay** The time that elapses between a drive failure and when the controller starts searching for spare dis space. Drive replacement seldom starts immediately in case the "failure" was a glitch or temporary condition.

**drive blank** *See* disk drive blank.

**drive enclosure** *See* disk drive enclosure.

**dual-loop** A configuration where each drive is connected to a pair of controllers through two loops. These two Fibre Channel loops constitute a loop pair.

**dual power supply configuration** *See* redundant power configuration.

**EIA** Electronic Industries Alliance. A standards organization specializing in the electrical and functional characteristics of interface equipment.

**EIP** Event Information Packet. The event information packet is an HSV element hexadecimal character display that defines how an event was detected. Also called the EIP type.

**electromagnetic interference** *See* EMI.

**electrostatic discharge** *See* ESD.

**element**
1. In a disk drive enclosure, a device such as an EMU, power supply, disk, blower, or I/O module. The object can be controlled, interrogated, or described by the enclosure services process.
2. In the Open SAN Manager, a controllable object, such as the Enterprise storage system.

**Element Manager GUI** The graphical user interface (GUI) through which a user can control and monitor a storage system. Command View EVA can be installed on more than one storage management appliance in a fabric. Each installation is a management agent. The client for the agent is a standard browser.

**EMI** Electromagnetic Interference. The impairment of a signal by an electromagnetic disturbance.

**EMU** Environmental Monitoring Unit. An element which monitors the status of an enclosure, including the power, air temperature, and blower status. The EMU detects problems and displays and reports these conditions to a user and the controller. In some cases, the EMU implements corrective action.

**enclosure** A unit used to hold various storage system devices such as disk drives, controllers, power supplies, blowers, an EMU, I/O modules, or blowers.

**enclosure address bus** An Enterprise storage system bus that interconnects and identifies controller enclosures and disk drive enclosures by their physical location. Enclosures within a reporting group can exchange environmental data. This bus uses junction boxes and cables to assign enclosure numbers to each enclosure. Communications over this bus do not involve the FC-AL bus and are, therefore, clssified as out-of-band communications.

**enclosure number (En)** One of the vertical rack-mounting positions where the enclosure is located. The positions are numbered sequentially in decimal numbers starting from the bottom of the cabinet. Each disk enclosure has its own enclosure number. A controller pair shares an enclosure number. If the system has an expansion rack,

the enclosures in the expansion rack are numbered from 15 to 24, starting at the bottom.

**enclosure services** Those services that establish the mechanical environmental, electrical environmental, and external indicators and controls for the proper operation and maintenance of devices with an enclosure as described in the *SES SCSI-3 Enclosure Services Command Set (SES), Rev 8b, American National Standard for Information Services*.

**Enclosure Services Interface** *See* ESI.

**Enclosure Services Processor** *See* ESP.

**Enterprise Virtual Array** The Enterprise Virtual Array is a product that consists of one or more storage systems. Each storage system consists of a pair of HSV controllers and the disk drives they manage. A storage system within the Enterprise Virtual Array can be formally referred to as an Enterprise storage system, or generically referred to as the storage system.

**Enterprise Virtual Array rack** A unit that holds controller enclosures, disk drive enclosures, power distribution supplies, and enclosure address buses that, combined, comprise an Enterprise storage system solution. *Also* called the Enterprise storage system rack. *See also* rack.

**environmental monitoring unit** *See* EMU.

**error code** The portion of an EMU condition report that defines a problem.

**ESD** Electrostatic Discharge. The emission of a potentially harmful static electric voltage as a result of improper grounding.

**ESI** Enclosure Services Interface. The SCSI-3 engineering services interface implementation developed for StorageWorks products. A bus that connects the EMU to the drives.

**ESP** Enclosure Services Processor. An EMU that implements an enclosure's services process.

**event** Any significant change in the state of the Enterprise storage system hardware or software component reported by the controller to Command View EVA. *See also* controller event, disk drive enclosure event, management agent event, and termination event.

**Event Information Packt** *See* EIP.

**Event Number** *See* Evt No.

**Evt No.** Event Number. A sequential number assigned to each Software Code Identification (SWCID) event. It is a decimal number in the range 0-255.

**exabyte** A unit of storage capacity that is the equivalent of $2^{60}$ bytes or 1,152,921,504,606,846,976 bytes. One exabyte is equivalent to 1,024 petabytes.

**fabric** A Fibre Channel fabric switch or two or more interconnected Fibre Channel switches allowing data transmission.

**fabric port** A port which is capable of supporting an attached arbitrated loop. This port on a loop will have the AL_PA hexadecimal address 00 (loop ID 7E), giving the fabric the highest priority access to the loop. A loop port is the gateway to the fabric for the node ports on a loop.

**failover** The process that takes place when one controller assumes the workload of a failed companion controller. Failover continues until the failed controller is operational.

**fan** The variable speed airflow device that cools an enclosure or element by forcing ambient air into an enclosure or element and forcing heated air out the other side.
*See also* blower.

**Fault Management Code** *See* FMC.

**FC-AL** Fibre Channel Arbitrated Loop. The American National Standards Institute's (ANSI) document which specifies arbitrated loop topology operation.

**FC HBA** Fibre Channel Host Bus Adapter. An interchangeable term for Fibre Channel adapter.
*See also* FCA.

**FCA** Fibre Channel Adapter. An adapter used to connect the host server to the fabric. *Also* called a Host Bus Adapter (HBA) or a Fibre Channel Host Bus Adapter (FC HBA).
*See also* FC HBA.

**FCC** Federal Communications Commission. The federal agency responsible for establishing standards and approving electronic devices within the United States.

**FCP** Fibre Channel Protocol. The mapping of SCSI-3 operations to Fibre Channel.

**fiber** The optical media used to implement Fibre Channel.

**fiber optics** The technology where light is transmitted through glass or plastic (optical) threads (fibers) for data communication or signaling purposes.

**fiber optic cable** A transmission medium designed to transmit digital signals in the form of pulses of light. Fiber optic cable is notd for its properties of electrical isolation and resistance to electrostatic contamination.

**fibre** The international spelling that refers to the Fibre Channel standards for optical media.

**Fibre Channel** A data transfer architecture designed for mass storage devices and other peripheral devices that require very high bandwidth.

**Fibre Channel adapter** *See* FCA.

**Fibre Channel Loop Switch** An enclosure that provides twelve-port central interconnect for Fibre Channel Arbitrated Loops following the ANSI FC-AL standard.

**field replaceable unit** *See* FRU.

**flush** The act of writing dirty data from cache to a storage media

**FMC** Fault Management Code. The Command View EVA display of the Enterprise Storage System error condition information.

**form factor** A storage industry dimensional standard for 3.5inch (89 mm) and 5.25inch (133 mm) high storage devices. Device heights are specified as low-profile (1inch or 25.4 mm), half-height (1.6inch or 41 mm), and full-height (5.25inch or 133 mm).

**FPGA** Field Programmable Gate Array. A programmable device with an internal array of logic blocks surrounded by a ring of programmable I/O blocks connected together through a programmable interconnect.

**frequency** The number of cycles that occur in one second expressed in Hertz (Hz). Thus, 1 Hz is equivalent to one cycle per second.

**FRU** Field Replaceable Unit. A hardware element that can be replaced in the field. This type of replacement can require special training, tools, or techniques. Therefore, FRU procedures are usually performed only by an Authorized Service Representative.

**Gb** Gigabit. A measurement of the rate at which the transfer of bits of data occurs. Sometimes referred to as Gbps. Nominally, a Gb is a transfer rate of 1,000,000,000 ($10^9$) bits per second.
For Fibre Channel transceivers or FC loops the Gb transfer rates are:

- 1 Gb is a transmission rate of 1,062,500,000 bits per second.
- 2 Gb is a transmission rate of 2,125,000,000 bits per second.

**GB** Gigabyte. A unit of measurement defining either:

- A data transfer rate.
- A storage or memory capacity of 1,073,741,824 ($2^{30}$) bytes.

*See also* GBps.

**Gbps** Gigabits per second. A measurement of the rate at which the transfer of bits of data occurs. Nominally, a Gb is a transfer rate of 1,000,000,000 ($10^9$) bits per second.
*See also* Gb.

**GBps** Gigabytes per second. A measurement of the rate at which the transfer of bytes of data occurs. A GBps is a transfer rate of 1,000,000,000 ($10^9$) bytes per second.
*See also* GB.

**Giga (G)** The notation to represent $10^9$ or 1 billion (1,000,000,000).

**gigabaud** An encoded bit transmission rate of one billion ($10^9$) bits per second.

**gigabit** *See* Gb.

**gigabit per second** *See* Gbps.

**graphical user interface** *See* GUI.

**GUI** Graphical User Interface. Software that displays the status of a storage system and allows its user to control the storage system.

**HBA** Host Bus Adapter.
*See also* FCA.

**host** A computer that runs user applications and uses (or can potentially use) one or more virtual disks created and presented by the controller pair.

**Host Bus Adapter** *See* FCA.

**host computer** *See* host.

**host link LED** The HSV Controller display that indicates the status of the storage system Fibre Channel links.

**host ports** A connection point to one or more hosts through a Fibre Channel fabric. A host is a computer that runs user applications and that uses (or can potentially use) one or more of the virtual disks that are created and presented by the controller pair.

**host-side ports** *See* host ports.

**hot-pluggable** A method of element replacement whereby the complete system remains operational during element removal or insertion. Replacement does not interrupt data transfers to other elements.

**hub** A communications infrastructure device to which nodes on a multi-point bus or loop are physically connected. It is used to improve the manageability of physical cables.

**I/O module** Input/Output module. The enclosure element that is the FC-AL interface to the host or controller. I/O modules are bus speedspecific, either 1 Gb or 2 Gb.

**IDX** A 2-digit decimal number portion of the HSV controller termination code display that defines one of 32 locations in the Termination Code array that contains information about a specific event.
*See also* param and TC.

**in-band communication** The method of communication between the EMU and controller that utilizes the FC-AL bus.

**INFORMATION condition** A disk drive enclosure EMU condition report that may require action. This condition is for information only and does not indicate the failure of an element. All condition reports have precedence over an INFORMATION condition.

**initialization** A process that prepares a storage system for use. Specifically, the system binds controllers together as an operational pair and establishes preliminary data structures on the disk array. Initialization also sets up the first disk group, called the default disk group.

**input/output module** *See* I/O module.

**intake temperature** *See* ambient temperature.

**interface** A set of protocols used between components such as cables, connectors, and signal levels.

**JBOD** Just a Bunch of Disks. A number of disks connected to one or more controllers.

**just a bunch of disks** *See* JBOD.

**K** Kilo. A scientific notation denoting a multiplier of one thousand (1,000).

**KB** Kilobyte. A unit of measurement defining either storage or memory capacity.

1. For storage, a KB is a capacity of 1,000 ($10^3$) bytes of data.
2. For memory, a KB is a capacity of 1,024 ($2^{10}$) bytes of data.

**LAN** Local area network. A group of computers and associated devices that share a common communications line and typically share the resources of a single processor or server within a small geographic area.

**laser** A device that amplifies light waves and concentrates them in a narrow, very intense beam.

**Last Fault View** An HSV Controller display defining the last reported fault condition.

**Last Termination Error Array** *See* LTEA.

**LCD** Liquid Crystal Display. The indicator on a panel that is associated with an element. The LCD is usually located on the frot of an element.

**LED** Light Emitting Diode. A semiconductor diode, used in an electronic display, that emits light when a voltage is applied to it.

**License Key** A WWN-encoded sequence that is obtained from the license key fulfillment Web site.

**light emitting diode** *See* LED.

**link** A connection between ports on Fibre Channel devices. The link is a full duplex connection to a fabric or a simplex connection between loop devices.

**logon** *Also* called login, it is a procedure whereby a user or network connection is identified as being an authorized network user or participant.

**loop** *See* arbitrated loop.

**loop ID** Seven-bit values numbered contiguously from 0 to 126 decimal and represent the 127 valid AL_PA values on a loop (not all 256 hexadecimal values are allowed as AL_PA values per FC–AL).

**loop pair** A Fibre Channel attachment between a controller and physical disk drives. Physical disk drives connect to controllers through paired Fibre Channel arbitrated loops. There are two loop pairs, designated loop pair 1 and loop pair 2. Each loop pair consists of two loops (called loop A and loop B) that operate independently during normal operation, but provide mutual backup in case one loop fails.

**LTEA** Last Termination Event Array. A two-digit HSV Controller number that identifies a specific event that terminated an operation. Valid numbers range from 00 to 31.

**LUN** Logical Unit Number. A SCSI convention used to identify elements. The host sees a virtual disk as a LUN. The LUN address a user assigns to a virtual disk for a particular host will be the LUN at which that host will see the virtual disk.

**management agent** The Command View EVA software that controls and monitors the Enterprise storage system. The software can exist on more than one management appliance in a fabric. Each installation is a management agent.

**management agent event** Significant occurrence to or within the management agent software, or an initialized storage cell controlled or monitored by the management agent.

**Mb** Megabit. A term defining a data transfer rate.
*See also* Mbps.

**MB** Megabtye. A term defining either:

- A data transfer rate.
- A measure of either storage or memory capacity of 1,048,576 ($2^{20}$) bytes.

*See also* MBps.

**Mbps** Megabits per second. A measure of badwidth or data transfers occurring at a rate of 1,000,000 ($10^6$) bits per second.

**MBps** Megabytes per second. A measure of bandwidth or data transfers occurring at a rate of 1,000,000 ($10^6$) bytes per second.

**mean time between failures** *See* MTBF.

**Mega** A notation denoting a multiplier of 1 million (1,000,000).

**metadata** Information that a controller pair writes on the disk array. This information is used to control and monitor the array and is not readable by the host.

**micro meter** *See* µm.

**mirrored caching** A process in which half of each controller's write cache mirrors the companion controller's write cache. The total memory available for cached write data is reduced by half, but the level of protection is greater.

**mirroring** The act of creating an exact copy or image of data.

**MTBF** Mean Time Between Failures. The average time from start of use to first failure in a large population of identical systems, components, or devices.

**multi-mode fiber** A fiber optic cable with a diameter large enough (50 microns or more) to allow multiple streams of light to travel different paths from the transmitter to the receiver. This transmission mode enables bidirectional transmissions.

**Network Storage Controller** *See* NSC.

**NONCRITICAL Condition** A disk drive enclosure EMU condition report that occurs when one or more elements inside the enclosure have failed or are operating outside of their specifications. The failure does not affect continued normal operation of the enclosure. All devices in the enclosure continue to operate according to their specifications. The ability of the devices to operate correctly may be reduced if additional failures occur. UNRECOVERABLE and CRITICAL errors have precedence over this condition. This condition has precedence over INFORMATION condition. *Early correction can prevent the loss of data.*

**node port** A device port that can operate on the arbitrated loop topology.

**non-OFC (Open Fibre Control)** A laser transceiver whose lower-intensity output does not require special open Fibre Channel mechanisms for eye protection. The Enterprise storage system transceivers are non-OFC compatible.

**NSC** Network Storage Controller. The HSV Controllers used by the Enterprise storage system.

**NVRAM** Nonvolatile Random Access Memory. Memory whose contents are not lost when a system is turned Off or if there is a power failur. This is achieved through the use of UPS batteries or implementation technology such as flash memory. NVRAM is commonly used to store important configuration parameters.

**occupancy alarm level** A percentage of the total disk group capacity in blocks. When the number of blocks in the disk group that contain user data reaches this level, an event code is generated. The alarm level is specified by the user.

**OCP** Operator Control Panel. The element that displays the controller's status using LEDs and an LCD. Information selection and data entry is controlled by the OCP push buttons.

**online/nearonline** An online drive is a normal, high-perfomance drive, while a near-online drive is a lower-performance drive.

**operator control panel** *See* OCP.

**OpenView Storage Management Appliance** A centralized, appliance-based monitoring and management interface that supports multiple applications, operating systems, hardware platforms, storage systems, tape libraries and SAN-related interconnect devices. It is included and resides on the SANWorks Management Appliance, a single aggregation point for data management.

**param** That portion of the HSV controller termination code display that defines:

- The 2-character parameter identifier that is a decimal number in the 0 through 30 range.
- The 8-character parameter code that is a hexadecimal number.

*See also* IDX and TC.

**password** A security interlock where the purpose is to allow:

- A management agent to control only certain storage systems
- Only certain management agents to control a storage system

**PDM** Power Distribution Module. A thermal circuit breaker-equipped power strip that distributes power from a PDU to Enterprise Storage System elements.

**PDU** Power Distribution Unit. The rack device that distributes conditioned AC or DC power within a rack.

**petabyte** A unit of storage capacity that is the equivalent of $2^{50}$, 1,125,899,906,842,624 bytes or 1,024 terabytes.

**physical disk** A disk drive mounted in a disk drive enclosure that communicates with a controller pair through the device-side Fibre Channel loops. A physical disk is hardware with embedded software, as opposed to a virtual disk, which is constructed by the controllers. Only the controllers can communicate directly with the physical disks.
The physical disks, in aggregate, are called the array and constitute the storage pool from which the controllers create virtual disks.

**physical disk array** *See* array.

**port** A Fibre Channel connector on a Fibre Channel device.

**port_name** A 64-bit unique identifier assigned to each Fibre Channel port. The port_name is communicated during the login and port discovery processes.

**port-wine colored** A convention of applying the color of port wine to a CRU tab, lever, or handle to identify the unit as hot-pluggable.

**power distribution module** *See* PDM.

**power distribution unit** *See* PDU.

**power supply** An element that develops DC voltages for operating the storage system elements from either an AC or DC source.

**preferred address** An AL_PA which a node port attempts to acquire during loop initialization.

**preferred path** A preference for which controller of the controller pair manages the virtual disk. This preference is set by the user through the element manager when creating the virtual disk. A host can change the preferred path of a virtual disk at any time. The primary purpose of preferring a path is load balancing.

**protocol** The conventions or rules for the format and timing of messages sent and received.

**push button** A switch that is engaged or disengaged when it is pressed.

**quiesce** The act of rendering bus activity inactive or dormant. For example, "quiesce the SCSI bus operations during a device warm-swap."

**rack** A floorstanding structure primarily designed for, and capable of, holding and supporting storage system equipment. All racks provide for the mounting of panels per Electronic Industries Alliance (EIA) *Standard RS310C*.

**rack-mounting unit** A measurement for rack heights based upon a repeating hole pattern. It is expressed as "U" spacing or panel heights. Repeating hole patterns are spaced every 1.75 inches (44.45 mm) and based on EIA's *Standard RS310C*. For example, a 3U unit is 5.25inches (133.35 mm) high, and a 4U unit is 7.0inches (177.79 mm) high.

**read caching** A cache method used to decrease subsystem response times to a read request by allowing the controller to satisfy the request from the cache memory rather than from the disk drives. Reading data from cache memory is faster than reading data from a disk. The read cache is specified as either On or Off for each virtual disk. The default state is on.

**read ahead caching** A cache management method used to decrease the subsystem response time to a read request by allowing the controller to satisfy the requst from the cache memory rather than from the disk drives.

**reconstruction** The process of regenerating the contents of a failed member data. The reconstruction process writes the data to a spare set disk and incorporates the spare set disk into the mirrorset, striped mirrorset or RAID set from which the failed member came.

**redundancy**

1. Element Redundancy—The degree to which logical or physical elements are protected by having another element that can take over in case of failure. For example, each loop of a device-side loop pair normally works independently but can take over for the other in case of failure.
2. Data Redundancy—The level to which user data is protected. Redundancy is directly proportional to cost in terms of storage usage; the greater the level of data protection, the more storage space is required.

**redundant power configuration** A capability of the Enterprise storage system racks and enclosures to allow continuous system operation by preventing single points of power failure.

- For a rack, two AC power sources and two power conditioning units distribute primary and redundant AC power to enclosure power supplies.
- For a controller or disk drive enclosure, two power supplies ensure that the DC power is available even when there is a failure of one supply, one AC source, or one power conditioning unit. Implementing the redundant power configuration provides protection against the loss or corruption of data.

**reporting group** An Enterprise Storage System controller pair and the associated disk drive enclosures. The Enterprise Storage System controller assigns a unique decimal reporting group number to each EMU on its loops. Each EMU collects disk drive environmental information from its own sub-enclosure and broadcasts the data over the enclosure address bus to all members of the reporting group. Information from enclosures in other reporting groups is ignored.

**room temperature** *See* ambient temperature.

**SCSI**
1. Small Computer System Interface. An American National Standards Institute (ANSI) interface which defines the physical and electrical parameters of a parallel I/O bus used to connect computers and a maximum of 16 bus elements.
2. The communication protocol used between a controller pair and the hosts. Specifically, the protocol is FC-AL or SCSI on Fibre Channel. SCSI is the higher command-level protocol and Fibre Channel is the low-level transmission protocol. The controllers have full support for SCSI-2; additionally, they support some elements of SCSI-3.

**SCSI-3** The ANSI standard that defines the operation and function of Fibre Channel systems.

**SCSI-3 Enclosure Services** *See* SES.

**selective presentation** The process whereby a controller presents a virtual disk only to the host computer which is authorized access.

**serial transmission** A method of transmission in which each bit of information is sent sequentially on a single channel rather than simultaneously as in parallel transmission.

**SES** SCSI-3 Enclosures Services. Those services that establish the mechanical environment, electrical environment, and external indicators and controls for the proper operation and maintenance of devices within an enclosure.

**small computer system interface** *See* SCSI.

**Snapclone** A virtual disk that can be manipulated while the data is being copied. Only an Active member of a virtual disk family can be snapcloned.
The Snapclone, like a snapshot, reflects the contents of the source virtual disk at a particular point in time. Unlike the snapshot, the Snapclone is an actual clone of the source virtual disk and immediately becomes an independent Active member of its own virtual disk family.

**snapshot** A temporary virtual disk (Vdisk) that reflects the contents of another virtual disk at a particular point in time. A snapshot operation is only done on an active virtual disk. Up to seven snapshots of an active virtual disk can exist at any point. The active disk and its snapshot constitute a virtual family.
*See also* active virtual disk, virtual disk copy, and virtual disk family.

**SSN** Storage System Name. A Command View EVA-assigned, unique 20-character name that identifies a specific storage system.

**storage carrier** *See* carrier.

**storage pool** The aggregated blocks of available storage in the total physical disk array.

**storage system** The controllers, storage devices, enclosures, cables, and power supplies and their software.

**Storage System Name** — *See* SSN.

**switch** — An electro-mechanical device that initiates an action or completes a circuit.

**TB** — Terabyte. A term defining either:

- A data transfer rate.
- A measure of either storage or memory capacity of 1,099,5111,627,776 ($2^{40}$) bytes.

*See also* TBps.

**TBps** — Terabytes per second. A data transfer rate of 1,000,000,000,000 ($10^{12}$) bytes per second.

**TC** — Termination Code. An Enterprise Storage System controller 8-character hexadecimal display that defines a problem causing controller operations to halt. *See also* DX and param.

**Termination Code** — *See* TC.

**termination event** — Occurrences that cause the storage system to cease operation.

**terminator** — Interconnected elements that form the ends of the transmission lines in the enclosure address bus.

**topology** — An interconnection scheme that allows multiple Fibre Channel ports to communicate. Point-to-point, arbitrated loop, and switched fabric are all Fibre Channel topologies.

**transceiver** — The device that converts electrical signals to optical signals at the point where the fiber cables connect to the FC elements such as hubs, controllers, or adapters.

**uninitialized system** — A state in which the storage system is not ready for use.
*See also* initialization.

**units** — *See* rack-mounting units.

**UNRECOVERABLE Condition** — A disk drive enclosure EMU condition report that occurs when one or more elements inside the enclosure have *failed* and have disabled the enclosure. The enclosure may be incapable of recovering or bypassing the failure and will require repairs to correct the condition.
This is the highest level condition and has precedence over all other errors and requires *immediate corrective action*.

**unwritten cached data** — *Also* called unflushed data.
*See also* dirty data.

**UPS** — Uninterruptible Power Supply. A battery-operated power supply guaranteed to provide power to an electrical device in the event of an unexpected interruption to the primary power supply. Uninterruptible power supplies are usually rated by the amount of voltage supplied and the length of time the voltage is supplied.

**VCS** — Virtual Controller Software. Provides storage controller software capability for the HSV Controller.

**Vdisk** — Virtual Disk. A simulated disk drive created by the controllers as storage for one or more hosts. The virtual disk characteristics, chosen by the storage administrator, provide a specific combination of capacity, availability,

performance, and accessibility. A controller pair simulates the characteristics of the virtual disk by deploying the disk group from which the virtual disk was created.
The host computer sees the virtual disk as "real," with the characteristics of an identical physical disk.
*See also* active virtual disk, virtual disk copy, virtual disk family, and virtual disk snapshot.

**virtual disk** — *See* Vdisk.

**virtual disk copy** — A clone or exact replica of another virtual disk at a particular point in time. Only an active virtual disk can be copied. A copy immediately becomes the active disk of its own virtual disk family.
*See also* active virtual disk, virtual disk family, and virtual disk snapshot

**virtual disk family** — A virtual disk and its snapshot, if a snapshot exists, constitute a family. The original virtual disk is called the active disk. When you first create a virtual disk family, the only member is the active disk.
*See also* active virtual disk, virtual disk copy, and virtual disk snapshot.

**virtual disk snapshot** — *See* snapshot.

**Vraid0** — A virtualization technique that provides no data protection. Data host is broken down into chunks and distributed on the disks comprising the disk group from which the virtual disk was created. Reading and writing to a Vraid0 virtual disk is very fast and makes the fullest use of the available storage, but there is no data protection (redundancy) unless there is parity.

**Vraid1** — A virtualization technique that provides the highest level of data protection. All data blocks are mirrored or written twice on separate physical disks. For read requests, the block can be read from either disk, which can increase performance. Mirroring takes the most storage space because twice the storage capacity must be allocated for a given amount of data.

**Vraid5** — A virtualization technique that uses parity striping to provide moderate data protection. Parity is a data protection mechanism for a striped virtual disk. A striped virtual disk is one where the data to and from the host is broken down into chunks and distributed on the physical disks comprising the disk group in which the virtual disk was created. If the striped virtual disk has parity, another chunk (a parity chunk) is calculated from the set of data chunks and written to the physical disks. If one of the data chunks becomes corrupted, the data can be reconstructed from the parity chunk and the remaining data chunks.

**World Wide Name** — *See* WWN.

**write back caching** — A controller process that notifies the host that the write operation is complete when the data is written to the cache. This occurs before transferring the data to the disk. Write back caching improves response time since the write operation completes as soon as the data reaches the cache. As soon as possible after caching the data, the controller then writes the datato the disk drives.

**write caching** — A process when the host sends a write request to the controller, and the controller places the data in the controller cache module. As soon as possible, the controller transfers the data to the physical disk drives.

**WWN** — World Wide Name. A unique Fibre Channel identifier consisting of a 16-character hexadecimal number. A WWN is required for each Fibre Channel communication port.

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